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International Symposium on Surface Transportation System Performance

October 1981

ORIGINAL

Office of the Secretary of Transportation
Urban Mass Transportation Administration
Federal Highway Administration

Proceedings/Volume I

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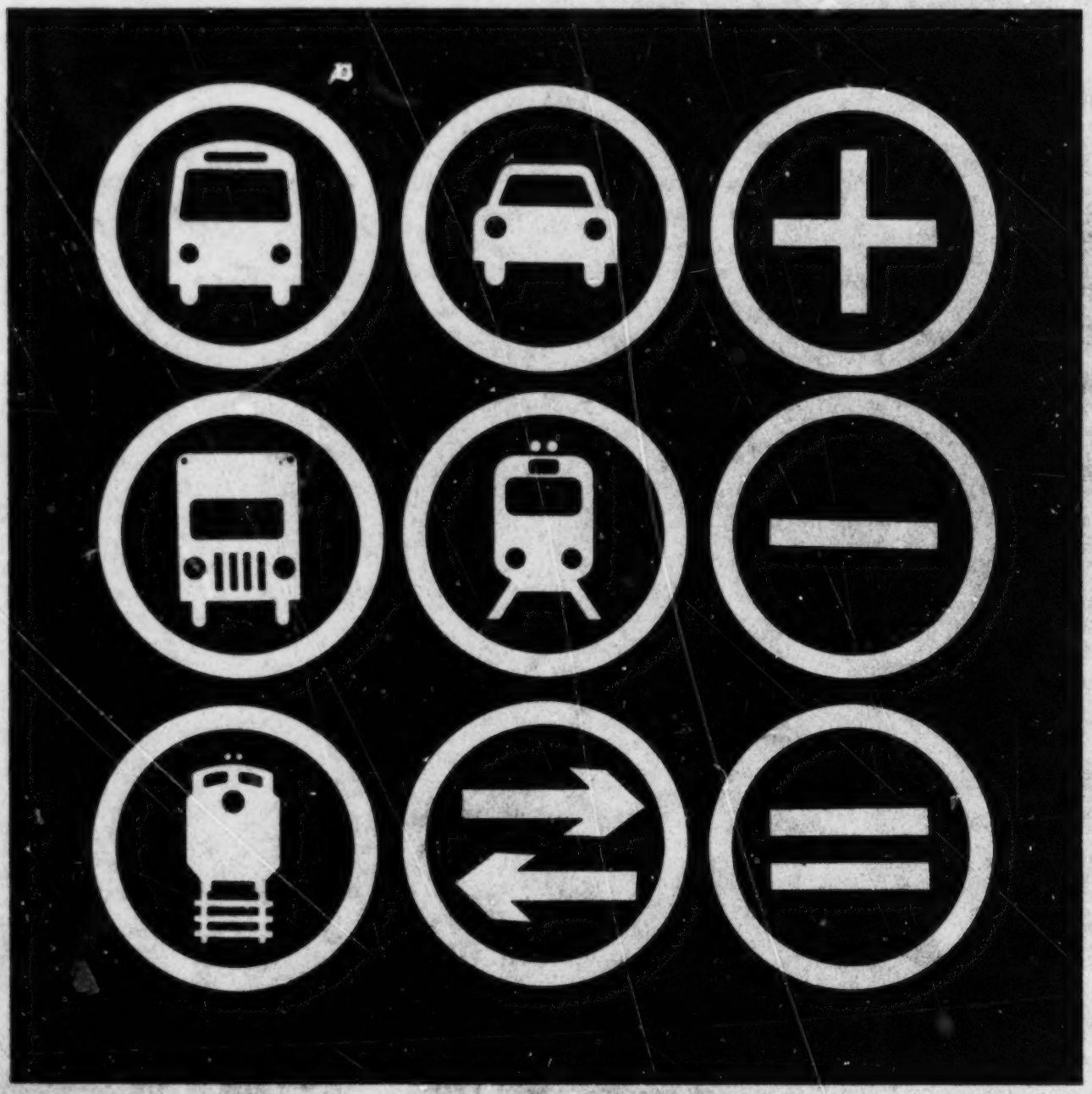

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Proceedings/Volume I

International Symposium on Surface Transportation System Performance

October 1981

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OFFICE OF THE SECRETARY OF TRANSPORTATION
WASHINGTON, D.C. 20590

ASSISTANT SECRETARY

December 1981

I wish to bring to your attention these Proceedings which contain a summary report of the International Symposium on Surface Transportation System Performance convened at the U.S. Department of State in May 1981. The Symposium was held to identify and discuss common approaches to the evaluation of transportation system performance, and to define areas in which cooperative research could assist in developing more effective performance indicators and evaluation techniques.

The Symposium assembled approximately 250 distinguished transportation experts and officials from twenty countries who presented papers on the state-of-the-art in surface transportation system performance evaluation. The information compiled in these Proceedings reflects the interest of the participating countries to exchange information on the complex problem of evaluating these transportation systems.

The U.S. Department of Transportation is committed to developing a more efficient and effective transportation system for the citizens of the United States. This Symposium was a step toward establishing international cooperation on surface transportation so that we may be better able to evaluate these systems in the future. We especially thank the European Conference of Ministers of Transport, the Organization of Economic Cooperation and Development, the Transportation Research Board, our Rapporteur, and the members of the Steering and Technical Committees for their extraordinary efforts in making the Symposium a success.

Judith T. Connor

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III

Proceedings
of the
International Symposium on Surface Transportation System Performance

Volume I

Sponsored by:

U.S. Department of Transportation
Office of the Secretary
Urban Mass Transportation Administration
Federal Highway Administration

In Cooperation with:

European Conference of Ministers of Transport
Organization for Economic Cooperation
and Development
Transportation Research Board

October 1981

IV

PREFACE

The International Symposium on Surface Transportation System Performance was a three-day meeting consisting of general and focused discussions of the state-of-the-art, policy issues, and concepts and definitions used in the evaluation of the performance of transportation systems. The overall motivation for the Symposium was to provide a forum in which transportation officials, policymakers and technical experts could explore the techniques and programs used by other countries to assess the efficiency and effectiveness of their transit systems. Specifically, five topics were chosen which focused the workshop session discussions on those areas which were and are of prime importance in the complex area of evaluating performance: energy conservation, economic development, urban form, impact of the transportation system on the environment, and safety.

The organization of these Proceedings follows generally the organization of the Symposium. The keynote speeches presented at the plenary sessions are provided in Volume I, together with summaries of the content of each of the fifteen workshop sessions, and a list of the Symposium participants. In Volume II, the complete texts of the fifty technical papers presented at the workshop sessions are recorded.

TABLE OF CONTENTS

Pages

INTRODUCTION 1

PRESENTATIONS AT SYMPOSIUM PLENARY SESSIONS:

Judith T. Connor 4
Assistant Secretary for Policy and International Affairs, U.S. Department of Transportation, Washington, D.C.

Drew Lewis 6
Secretary of Transportation, U.S. Department of Transportation, Washington, D.C.

Gerhard Aurbach 10
Deputy to the Secretary-General of the European Conference of Ministers of Transport, Paris, France

David Z. Beckler 15
Director, for Science, Technology and Industry, Organization for Economic Cooperation and Development, Paris, France

Thomas S. Deen 18
Executive Director, Transportation Research Board, National Academy of Sciences, Washington, D.C.

Charles D. Baker 20
Chairman, Harbridge House, Inc., Boston, Massachusetts

Edwin L. Harper 29
Deputy Director, Office of Management and Budget, Executive Office of the President, Washington, D.C.

SUMMARY REPORTS OF THE WORKSHOP SESSIONS: 40

Energy Conservation and the Transportation System 41

The Impact of the Transportation System on the Environment 48

The Transportation System and Urban Form 59

The Role of Transportation in Economic Development 66

Transportation System Safety 74

LIST OF PARTICIPANTS 83

INTRODUCTION

An International Symposium on Surface Transportation System Performance was held in Washington, D.C. on May 11-13, 1981, under the sponsorship of the United States Department of Transportation with the patronage of the European Conference of Ministers of Transport (ECMT) and the Organization for Economic Cooperation and Development (OECD), and in cooperation with the Transportation Research Board of the National Academy of Sciences. In attendance were 250 participants from 17 countries, mainly from Western Europe and North America.

The Symposium was designed to provide a forum for the exchange of information and ideas on issues of interest to transportation officials, policy-makers, and technical experts and to focus international attention on common approaches to policy analysis of transportation system performance. It was anticipated that these meetings and discussions would yield a set of recommendations on cooperative research activities that might be undertaken.

Preparations for the Symposium were begun approximately one year in advance. They involved, among other things, the establishment of an appropriate format and agenda, arrangements for logistical support, issuance of invitations to qualified participants, selection of panelists, and acquisition, reproduction and distribution of 50 technical papers submitted by experts in specialized areas of transportation.

The agenda dealt with five specific topics of major importance and interest in the field of surface transportation. For each topic, three workshops were scheduled, with the presentation of relevant technical papers preceding general discussion. The three workshop subtopics focused, respectively, on:

- state of the art, including an outline of current practices;
- examination of performance concepts, indicators, and related data requirements;
- policy issues and implications, and identification of research needs and future cooperative activities.

The five major topics on which the Symposium centered were:

Energy Conservation and the Transportation System

Transportation and energy are the objects of considerable policy attention by all governments today. Among the principal issues to be addressed in this area were the interrelationships of transportation and energy and their effects on other sectors of the national economy; methods for measuring energy efficiency and effectiveness in transportation and their impact on social and economic policies; and strengths and weaknesses of current transportation/energy evaluation techniques.

The Impact of the Transportation System on the Environment

Transportation-related environmental impact analysis is a new and burgeoning field of study. It occurs in a highly sensitive political area, owing to the directly competing and sharply focused social values that come into play. Examination of this topic was to be undertaken from both a research and application perspective, with national points of view represented regarding the identification and resolution of transportation/environment conflicts.

The Transportation System and Urban Form

Transportation systems, and specifically transit systems, interact dynamically with the physical shape of an urban area, its geography, density, and the location of its homes, businesses, and services. Today, it affects most immediately housing development and occupancy, energy consumption, and land use. Discussion of this topic was expected to focus on current practices in measuring transportation/urban form interaction, clarification of existing performance measures and data needs, and identification and description of policy implications.

The Role of Transportation in Economic Development

Transportation's key role in economic development is widely recognized, but the precise relationship is not well understood. In this period of scarce physical and economic resources, the performance of the transportation sector and its overall effect on national economies are becoming issues of major concern. Sessions on this topic were expected to focus on the evaluation and development of analytical techniques, monitoring systems, and forecasting tools to provide decisionmakers with timely and pertinent information. Also to be examined were the ability of the transport system to carry traffic and the health of the transportation manufacturing sector.

Transportation System Safety

There is little agreement today on safety standards in transportation and on which safety programs are most efficient and effective. Issues expected to be addressed during the Symposium were safety aspects of transportation systems at both the policy and technical levels; successful safety techniques now being employed; quantitative measurements of safety performance; and research needed to improve safety decisions, including investigation of such matters as allocation of resources.

The opening plenary session featured a welcome address by United States Secretary of Transportation Drew L. Lewis; a key address by the Symposium Rapporteur Charles D. Baker, Chairman of Harbridge House, Inc., and remarks by Gerhard Aurbach, Deputy to the Secretary General, European Conference of

Ministers of Transport; David Z. Beckler, Director for Science, Technology and Industry, Organization for Economic Cooperation and Development; and Thomas B. Deen, Executive Director, Transportation Research Board. Edwin L. Harper, Deputy Director of the United States Office of Management and Budget, delivered a key address to symposium participants during the second day of the conference. Summaries of the various topic discussions were presented during the closing plenary by Daniel Roos, Director, Center for Transportation Studies, Massachusetts Institute of Technology; Norman W. Arnold, President, M & H Services; Ralph Gakenheimer, Professor, Urban Studies, Massachusetts Institute of Technology; Robert L. Calhoun, Partner, Sullivan and Worcester; and Martin Wohl, Faculty Fellow, Transportation Systems Center.

OPENING REMARKS
BY

Judith T. Connor
Assistant Secretary
For Policy and International Affairs
U.S. Department of Transportation
Washington, D.C.

I am delighted to be here and to be in the company of knowledgeable and experienced transportation policy makers and technical experts from such a large number of countries and from around the United States. I hope that you will take full advantage of these circumstances to have a full exchange of ideas and views on the topics selected for discussion. These are complex topics, made more so by the growing and shared recognition that solutions depend not simply on technical analysis, but also on the motivation of people, political realities, and limited resources.

Permit me to say a few words about my role in the U.S. Department of Transportation and then make some observations about the Department's international cooperation program.

My title reflects the two main functions of my office. I am the principal policy advisor to the Secretary of Transportation, and I am responsible for the Department's international activities--also, of course, under the direction of the Secretary.

Given the broad mandate of the Secretary of Transportation, we have many policy issues to address. Many of them will be mentioned by those of you who will be participating in the Symposium, so I will not discuss them at this time.

As for my international responsibilities, one of my priorities is to encourage and promote international cooperation and to gain access to foreign transportation experience and research by offering ours in return. We have cooperative arrangements with about 25 countries and international organizations in all phases of transportation, and I am pleased to observe that participants in this Symposium reflect the large number of countries with which we cooperate.

We believe these programs are extremely useful and have found them to yield reciprocal benefits to all parties. Moreover, we have benefitted from increased contacts with our foreign counterparts by acquiring a better understanding of the problems we share.

Let me turn now to my main task of introducing the U.S. Secretary of Transportation. In my opinion, President Reagan has already demonstrated his intent to be a dynamic leader. His selection of Drew Lewis as Secretary of

Transportation reflects a commitment to give transportation a major role in his cabinet.

The Secretary came to this Department with an extensive background in problem solving. For more than two decades Secretary Lewis had a successful business career, chiefly as a management consultant engaged in revitalizing troubled companies. In the transportation field, Secretary Lewis served as one of two court-appointed trustees of the Reading Company of Philadelphia. From 1971 to 1980, in his role as a co-trustee, Secretary Lewis guided the reoganization of the bankrupt Reading Railroad and its eventual conveyance to the consolidated corporation (Conrail).

The Secretary reflects the dynamic leadership of the Presidency and his enthusiasm and businessman's style permeate the Department.

It is with pleasure that I present Mr. Drew Lewis, Secretary of Transportation.

OPENING REMARKS
BY

The Honorable Drew Lewis
Secretary
U.S. Department of Transportation
Washington, D.C.

On behalf of President Reagan, I extend a warm welcome to all the delegates to this Symposium. I know that the planning for this program began more than a year ago, and that a great deal of work has been done to make this a mutually beneficial exchange. I want to express my appreciation to each of the sponsoring organizations, both for the individual efforts expended and for the excellent cooperation in bringing this program together.

I am especially pleased to welcome to this opening session Mr. Gerhard Aurbach, Mr. David Z. Beckler and Mr. Thomas B. Deen, the senior representatives of the organizations sharing with us in sponsoring this Symposium.

It will be my pleasure later this month to be in Europe--first in London to meet with transportation and trade officials, and then in Helsinki to take part in the European Council of Ministers of the European Conference of Ministers of Transport. I look forward to the opportunity those meetings afford to learn more about transportation progress in Europe.

This is National Transportation Week in the United States, a week set aside by Congressional act and Presidential proclamation to acknowledge the importance of transportation to our economy, our society and our individual lives. We depend heavily on our transportation systems and services, not only within our respective countries but for international trade and commerce. When a particular system doesn't measure up we must immediately ask "why" and "what can we do to fix it."

Our concerns at this symposium are directed toward the performance of our surface systems. There are three basic reasons for our growing interest in better system performance:

1. The rising costs of transportation systems--to build them, operate them, and maintain them--require that we get the maximum return possible on our investment.

2. The high costs of energy demand that we explore every possibility for improving system efficiencies.

3. The increasing economic importance of transportation obligates us to continually put our systems to the tests of cost-effectiveness, market value, and safety.

Transportation today is not simply a way to get around or move goods, important as those functions are. Transportation policies affect land-use patterns, the economy of communities, energy consumption and the safety of all who travel. And today, more than ever before, the production and marketing of transportation products can have a profound effect on a country's national economy and its balance of trade.

While the importance of these factors will vary from country to country, I am sure there is no nation represented here today that has not felt the harsh impact of worldwide inflation and the jarring effects of world energy prices. More than any other forces, these circumstances have compelled us to take a hard look at how well our transportation systems are performing.

In the United States, President Reagan's economic recovery program--which is getting strong support in the Congress--is designed to put more confidence in the private sector or our economy and in market forces, and to reduce the extent of government influence over transportation functions.

We believe that government's proper role is to create the economic climate within which the states can plan and carry out their transportation programs, and within which the operators of transportation services can supply the public demand, at the lowest possible cost to the taxpayer.

We want the Federal highway system, for example, to meet the highest performance standards for transportation efficiency, convenience and safety. In the United States 90% of our fresh food products and 70% of our commodities are transported over our highway system. The highways also carry 90% of all personal traffic--people traveling between cities and in the nation's rural areas. Our system of interstate highways alone, which account for only 1% of the total highway mileage in America, carries 20% of the total travel and a large percentage of our nation's commerce.

We are, therefore, very concerned about our responsibilities to the Interstate system; first, to complete it and, second, to keep it in good repair through adequate maintenance, resurfacing and reconstruction. For that reason, we propose to target construction funds to those segments of the Interstate not yet built, and to focus on the essentials--not the "finishing touches"--so that we can tie up the loose ends and get the system finished by 1990.

At the same time, we will begin to provide more Federal funds for rehabilitating the sections of the system that are wearing out. Our policy has been to fund Interstate construction at the 90% Federal/10% state ratio, and we propose the same formula for the reconstruction work. Highway performance is almost entirely a function of the road network itself--the quality of the pavement, the routing system and how well the highway is engineered for safety.

Similarly, in public transit, system performance in some of our cities--especially in the east--suffers from the problems of old age. While a few new rapid rail systems are being built (here in Washington, in Baltimore and in Atlanta), the basic New York subway is 65 years old, some of the rail cars

still in use in Philadelphia are 55 years old, and too many cities are still operating buses built in the 1950s.

We believe Federal funds can be used most effectively in capital assistance programs--to modernize commuter rail lines and help purchase new buses and rail cars. We feel we can do more for a city by funding 80% of the cost of a new bus than to pay a few cents toward the costs of operating a transit system.

As for railroads, we have never had the excellent system of passenger trains that Europeans enjoy, and it is perhaps too late in the day to try. We have been subsidizing 60% of the operating costs of our Amtrak system, and we believe that is asking too much of the taxpayers for a means of transportation that only a relatively few travelers in this country use.

We are recommending that Amtrak meet at least 50% of its operating costs, and that passenger rail service be concentrated in the most heavily-traveled intercity "corridors."

Rail freight service is generally profitable in the United States, and under recent legislation which removed many Federal regulations it has the potential for becoming more efficient and competitive. Certain railroads in the Midwest have been financially troubled and two have gone bankrupt. The Milwaukee is in reorganization and the Rock Island is being liquidated.

Our major concern at the moment is in the Northeast where the Conrail system--a government-organized and subsidized railroad--is burdened by high-cost labor protection and commuter service obligations that handicap its performance as a freight railroad.

We have invested $6.5 billion over the past 10 years to make Conrail a better railroad, and at present we have proposed legislation designed to improve rail freight service in the Northeastern United States by removing the labor protection and commuter costs and transferring the freight lines to privately-owned railroads.

We know that the bottom line--whether or not a system pays its own way--is not always the best or only performance test.

We don't expect the farebox to pay the full cost of public transit operations.

We don't expect passenger rail service to be self-sustaining.

But we do expect the costs of most transportation service to be met by the users. Our job, as I see it, is not to prop up inefficient systems through endless subsidies, but to focus Federal funds on those high pay-off areas where wise capital investments will result in better performance.

It is also our job to seek--through joint research, joint discussions and joint programs of cooperation--new and better approaches to the evaluation of system performance.

That is the purpose of this Symposium. It comes at a time when we are earnestly looking for greater efficiency, effectiveness and productivity in our transportation systems.

I believe we have much to offer at this Symposium; I know we have much to gain. I thank you for coming; again I bid you welcome; and I extend to each of you my appreciation for your contributions to better transportation performance, which is our common goal.

ADDRESS DELIVERED AT THE OPENING PLENARY SESSION
BY

Gerhard Aurbach
Deputy to the Secretary-General of the
European Conference of Ministers of Transport
Paris, France

It is both a great honour and personally gratifying for me to be able, on behalf of the European Conference of Ministers of Transports (ECMT), to address this Symposium attended by so many eminent representatives and to convey to you a message from one of the intergovernmental organizations which has accorded its co-sponsorship to this high-level meeting.

In doing so, I should first like to pay tribute to those who were responsible for organizing this important Symposium and have made such excellent arrangements for our meeting here in Washington. I am sure, moreover, that it is of no little consequence in terms of the results of our work that the meeting should be held here on the shores of the "New World", since we all know the extent to which our host country is concerned with research and analysis relevant to the future of our society. We are also familiar with the leading international role played by the United States in all spheres which have a bearing on economic development and the future of mankind. Everyone here today is fully aware of the part to be played in this context by the transport system and, in a broader sense, by the system of communications in today's world, the organization of which is marked, to such a high degree, by the intensive modbility of individuals, as well as increased trade in goods and flows of information.

Some of you to whom the European Conference of Ministers of Transport is not necessarily all that well known have perhaps wondered why and on what grounds the Conference was to participate in the present discussions, and it seems to me that I owe you some explanations in this respect. In offering these explanations, I should like, if I may, to develop certain lines of thought which do not bear directly on the specific topics on our agenda for the next three days (since it is not for me to anticipate the course the discussions will take), but which touch more on issues arising out of the activities in our programme and have a fundamental bearing on the very reason why we are meeting here today.

I should like to make two observations in this connection: the first relates to the convergence of our preoccupations, irrespective of national frontiers and institutions, the other to the key question of the relationship between research and policy decision-making in the transport sector.

First, however, may I say a few words about the organization on behalf of which I am addressing this meeting. As its name suggests, the ECMT is primarily a European organization which, more specifically, is at the service

of Ministers of Transport and hence of those responsible for the operation of the system at policy-making level. The Conference provides the Ministers with a forum for regular meetings to discuss together all matters of concern within their sphere of competence, to ascertain how the resources available to the transport system can best be used, to work together on matters of common interest and take the decisions called for in this connection. Set up in 1953, the Conference now includes 19 West European countries -- corresponding more or less to the Organization for Economic Cooperation and Development (OECD) European area -- and four non-European Associate Members: Australia, Canada, Japan and, last but not least, the United States.

While the Conference was initially conceived as a means of facilitating the operation and development of the European ground transport system, the participation of these Associate Members has meant that it must go beyond the purely European aspects in its thinking on and approaches to transport problems in order to integrate into its policy orientations the lessons to be drawn from the situations found and experience gained on a broader international front.

The fact is--and this is the point of my first observation--that the pattern of development of our societies, our economies and of transport technology itself, with all the positive and negative implications for man and his environment, has meant that the industrialized countries now have to cope with a number of major problems of a similar nature. Of course, the various aspects of these problems often take on a specific character according to the particular case and circumstances, since differences of many kinds necessarily exist among the various countries. Accordingly, the solutions found in a given context or case cannot always be directly applied, regardless of the circumstances, to similar problems arising in other places or in other countries, since each problem has its precise context which itself varies with the overall characteristics of the different countries.

However, there has been an increasing tendency, particularly over the last ten years, to adopt similar ways of tackling, identifying and analyzing the key problems and then planning the initial approach to resolving them. I believe that the presence of the associated countries within the ECMT has been a great help in working out a more universal approach to the major problems in the transport sector, an approach that is based on a broader range of experience.

Indeed, Mr. Chairman, the convergence of our main preoccupations could not be better illustrated than by reference to the general heading of the present Symposium and to the specific topics for the workshop sessions, since the aim that emerges is that of adapting the transport system to the needs of the community as economically as possible, an aim that is entirely consistent with achieving "the maximum use and most rational development" of the ground transport system which is the essential purpose assigned to the Conference.

The five specific topics for the working sessions, which relate to the energy situation, the environment, urban transport, safety and the role of transport in economic development, essentially mirror, moreover, the main lines of the Conference's present activities, the only difference being

perhaps that, from ECMT's viewpoint, problems relating to regional development and the social component in terms of labour could also be included.

What begins to emerge, therefore, is a whole range of factors which, in the present context, have a fundamental influence on decision-making in the transport sector. Most of these factors relate to constraints which are either specific to the economic activity of the sector or are an external nature. These constraints, together with the deep-seated, and to some extent, irreversible changes now taking place and whose full impact cannot as yet be accurately assessed, are henceforth part of a new reality which has to be taken into account in shaping transport policy.

In short, the aspects and dimensions of the problems to be solved differ from those of the past. A senior official with a wry sense of humour could say only five years ago: "In the transport sector, the questions are always fundamentally the same, but the answers found to them change from one year to the next." I think we must take great care to avoid the reverse situation whereby we give the same type of answer to questions which have themselves changed significantly.

In the adverse economic conditions we are now experiencing, the situation is further complicated by the desire to preserve, despite all kinds of constraints, the advantages we have obtained on a human and social level, and in terms of the quality of life.

The changing patterns of economic growth which will essentially differentiate the coming decade from the 1960s and even the 1970s clearly require us to adapt our policies to overcome all the difficulties, but they also prompt us to reconsider the shaping of the relationship between political action and work in the field of research.

This brings me to my second observation, and it is with some hesitancy that I approach the question of this relationship between science and practical implementation, which has so often been the subject of erudite debate on similar occasions. If I venture to say a few words on the subject, however, it is because I feel reassured by the ECMT's long tradition of this kind of interface between thought and action, theory and practice.

May I say, incidentally, that the scientific research carried out by the Conference follows a consistent pattern geared to the topical interest of the problems concerned and takes two forms: every two or three years, a symposium--somewhat like the present meeting--brings together some 300 participants from academic, government and business circles, trade unions, etc., in a word all those who are concerned with transport in a wide range of capacities, thus providing them with the opportunity to discuss the general problems of our time. For example, the subject of the last symposium in 1979 was "Transport and the Challenge of Structural Change," while that of the previous one was, in fact, "The Contribution of Economic Research to Transport Policy Decisions." As I look around me, moreover, it seems to me that many of those here today have already taken part in one or another of the ECMT's symposia.

The second form taken by the ECMT's scientific research consists of holding four or five Round Table meetings each year at which 15 or so people, chosen for their special qualifications, study a specific subject in-depth. The purpose of these Round Tables is to take stock of existing knowledge and formulate conclusions to provide Ministers with objective data in the light of which they may reach their policy decisions.

I shall not dwell on the details of these forms of research; suffice it to say that, in organising these meetings over many years, the ECMT has been convinced that theoretical analysis and policy decision-making should not be treated as if they were diametrically opposed activities. Steps should be taken to ensure that the effort in the two spheres of activity reach a point of convergence in the process of working out approaches to the problems which have become so difficult to handle at a time when the conditions governing the development of our economies are changing radically. This is all the more essential because, where the human sciences are concerned, problems must never be taken out of their social, economic and temporal context.

As I mentioned earlier, the point of convergence is to be sought within the framework of a new economic reality since, during the lengthy period of expansion we have experienced in recent decades, the continuous rise in productivity enabled us to absorb, perhaps not the errors relevant to major options, but at least some of the mistakes which took us off course in the policy-making sphere. It has also left us room enough to undertake any intellectual speculation that is necessary for development and, indeed, for working out economic theories.

To avoid any misunderstanding, I would at once add that it is by no means my intention to question the importance of basic research, which is by definition a free process of exploration and, as such, a true guarantee of progress in all disciplines.

From now on, however, much of the work will probably have to be planned in terms of practical requirements with a view to specific applications. This effort is consistent with the need for the type of rational co-operative approach which is always called for in a crisis in order to overcome tensions, prepare the future and preserve an overall balance on the socioeconomic level. In this context, research should be organized in terms of its social role and the various research activities should be largely carried out as functional contributions to a society whose need is greater than ever before.

While freedom is in principle essential to the full development of research, this is in fact to some extent only relative insofar as the research is increasingly directed along pre-determined channels. Reference may be made in particular to the areas of research covered by the programme for this Symposium, such as "Energy and Transport," "The Environment and Transport," "Safety and Transport" and "Urban Areas and Transport," not to mention others that might have been included.

The dialogue that has commenced over these three days in Washington will no doubt enable us to investigate these matters in greater depth.

In any event, it is with the prospect of a productive exchange of views, consonant with the patterns of development of the issues under consideration, and at the same time crossing frontiers and lines of demarcation between areas of activity, that, on behalf of the ECMT, I wish this Symposium every success.

POLICY CONCERNS IN TRANSPORTATION SYSTEM EVALUATION

David Z. Beckler
Director for Science, Technology and Industry
Organisation for Economic Cooperation and Development
Paris, France

It gives me great pleasure to address you at the occasion of this International Symposium on Surface Transportation System Performance. It is timely and fitting to hold this conference at an international level since transportation systems performance evaluation is a matter of increasing importance to many countries.

Government responsibilities and activities in transportation are probably more far reaching than in any other public sector of relevance to economic and social development. That is the reason why the Organisation for Economic Cooperation and Development (OECD)--which I am privileged to represent here--insisted to be associated with this Symposium as one of the international sponsoring agencies. On behalf of the Secretary General of OECD, I should like to congratulate the Department of Transportation for its initiative in holding the Symposium, and in inviting the governments of the OECD countries to attend this meeting. In particular, I would like to thank Dr. Voyce Mack, Deputy Director of the Office of International Policy and Programs of the U.S. Department of Transportation, who has admirably prepared this conference.

The scope and objectives of this Symposium are in line with the present overall concerns of the OECD. These have changed over the years.

In 1948, the United States provided Marshall Plan Aid through the Organisation for European Economic Cooperation (OEEC), to help in the reconstruction of war-torn European countries. By 1960, Europe was well on the road to economic recovery, and Canada, the United States, and 18 European countries formed the OECD. Later, Japan, Finland, Australia, and New Zealand became full Members; Yugoslavia decided to participate in certain aspects of OECD activities.

The concerns of OECD have widened through the years to include economic and trade policies, education, social affairs and labor, environment and urban concerns, energy, subjects relative to developing countries and science, technology and industry policy.

Today, OECD is giving priority attention to policies for overcoming the serious economic difficulties that confront its Member countries. A major task is to assess governmental options to combat persistent inflation and unemployment, to spur gradual adjustment, as well as to overcome lagging productivity and the effects of increased energy prices.

A very important share of our transportation-related work is carried out by the Road Research Programme. This Programme has three distinct tasks: first, to contribute to international policy assessments of key transportation issues; second, provide for a systematic exchange of scientific information and promote international technology-sharing; third, enhance multilateral research cooperation with the aim of stimulating new ideas and research directions.

I am proud that the idea for this conference stems, to a large extent, from the work of the OECD Road Research Group on Performance Evaluation of Urban Public Transport under the chairmanship of Mr. Bruce Barkley, Chief of the Policy Planning Division of the Federal Highway Administration.

* * *

In recent years, transportation has faced major difficulties involving financial constraints, environmental issues and energy problems. Nonetheless, transportation systems have proven to be robust and capable of adapting to these circumstances. There is a sustained tendency towards increased use of energy-efficient transportation means such as smaller cars, high-occupancy vehicles and carpooling. Freight transportation by road and railway continues to increase. Vehicle ownership is growing in almost all OECD countries.

Personal mobility and accessibility to activities are vital to the quality of life of people at all levels. They must be enhanced with special consideration of the needs of the transportation disadvantaged groups such as the handicapped, the elderly, the suburban and rural dwellers.

In the face of these trends and needs which are closely interwoven with conflicting socio-economic processes, the decision-maker has a special responsibility to spur discussion and evaluation of improved transportation strategies. Indeed it can be expected that future transportation investments and subsidies for service operation will come under even more stringent scrutiny in OECD countries than hitherto has been the case. The Symposium can help here in defining a logical framework and, in particular, a quantified basis for judgement in the light of available technical and scientific data and information from managerial and operational experience. There is a need to develop evaluation methodologies to facilitate assessment of public and private transportation performance with due regard to the growing range of interests and agents concerned.

This is best demonstrated in the traffic safety sector. Only by subjecting implemented safety projects to rigorous analysis is it possible to learn from established experience and to contribute to an enhanced traffic safety policy. Unfortunately, it is still common practice for decisions to be made and priorities chosen without detailed scrutiny of all potentially applicable safety measures. Even where evaluations are made, responsible authorities may prefer not to follow priorities thus determined because they did not include the necessary range of considerations, such as economic impacts, environmental effects, social attitudes and behavioral patterns--factors amongst which public acceptance appears to be important.

An emerging view of transportation policy is that planning, implementation and operation of activities in the transportation sector should be coordinated so as to achieve balance and integration of the services offered by the various modes, particularly in urban areas. Thus, performance evaluation must also reflect the multi-dimensional nature of transportation affecting the economy, the environment, land use and a wide range of other public issues. It must also, of course, cover the inherent links between the various transportation modes at both intra-urban and inter-urban levels; a matter which is of particular concern to many OECD countries.

To encourage and stimulate the development of transportation activities which respond to these concerns, countries are establishing institutional and participatory structures of decision-making which ensure the balance between economic, social, environmental and resource conservation needs and goals. To assist governments in these efforts, we hope that the Symposium will contribute to the identification of a clear conceptual basis for the development of system-wide indicators or packages of indicators which will enable the evaluation of transportation systems as a whole.

In the context of its discussion, the Symposium may consider the potential of technological innovation in the transportation sector. In a period of intensified scrutiny of public investment, it is likely that new developments in surface transportation will concentrate on innovative approaches in managing existing transportation systems rather than pursuing technological innovation in new systems development. There is also a need to promote research on measures that encourage new technologies that are more adaptable to present and foreseeable circumstances and existing transportation infrastructure, particularly to promote economy, energy saving and environmental quality.

Lastly, there is the very difficult issue of regulatory actions or changes. In many countries, a need is felt for reform of the technical and economic regulatory structure imposed on transportation providers by all levels of government. A central question is the impact of regulations on transportation productivity and innovation. Environmental regulations, fuel economy standards, and safety regulations are being reviewed in a number of countries. In this review, it is important to keep in mind the international dimension of regulations and the need to reinforce international cooperation and harmonization. For example, a very important problem emerging in OECD countries concerns the need to examine the impacts of the changing composition of the motor vehicle fleet towards smaller cars and heavier trucks. Exchange of international experience in this sector should provide a basis for the introduction of more effective traffic and safety policies.

* * *

In conclusion, Ladies and Gentlemen, may this Symposium be successful and provide an up-to-date international assessment of the present state of understanding of surface transportation system performance. Hopefully, it will provide a comprehensive agenda for future research in this field. We, at OECD, will give serious consideration to these future research needs within the framework of our activities.

ADDRESS DELIVERED AT THE OPENING PLENARY SESSION
BY

Thomas S. Deen
Executive Director
Transportation Research Board
National Academy of Sciences
Washington, D.C.

On behalf of the Transportation Research Board (TRB) and the National Academy of Sciences (NAS), I want to welcome you to the United States and to this Symposium. As you have heard, TRB is one of the agencies cooperating in the sponsorship of this series of meetings and, in fact, some of the sessions will be held during the week in the main building of the NAS, located just across the street. Although it is not a government agency, the Academy has a Congressional Charter signed by President Abraham Lincoln in 1863, and was set up to honor the nation's distinguished scientists and engineers, and to provide advice on technology to government when requested.

TRB was started within NAS over 60 years ago in order to provide a mechanism for sharing research and other findings between the many thousands of agencies, both private and public, that plan, build, operate, maintain and finance our transportation system. Over the years, relationships have been established with similar institutions in other countries in order to further this exchange of information. Many of you are familiar with TRB as a result of attendance at one of our annual meetings (4,000 participants and several hundred from outside the U.S.), or through use of our publications. We at TRB hope that we will have the opportunity to know you better as a result of your visit here this week.

Two basic thrusts contribute to the interest of TRB in this international Symposium. The first is that the meeting's purpose is the sharing of what we each have learned about transportation system performance in each of our unique political, economic and cultural contexts. From such a sharing, we can collectively obtain insights which will reduce chances of us all making the same mistakes and allow us to focus on what seems to be working. Such sharing is, of course, squarely in the mainstream of TRB's main mission.

The second thrust comes from the growing awareness of our interdependence in the world, economically and technologically. If we are to individually succeed, there is an increasing sense in which we all must succeed. Transportation fits well within this economic and technological envelope, and sharing our knowledge and experience will make a contribution to our success in the field.

Before closing, I want to express a growing concern about the level of research being directed at transportation. Most of the United States' transportation systems are in private hands and financial difficulties have

caused significant reductions in funds for research. In Government, we have experienced a drop of 40% in research dollars (discounting for inflation). For highways, we are now spending less than .2%. Filling potholes is important, but we need to spend some to find ways to fill them better in the future. We must learn ways to make our research dollars perform better if we are to attract scarce dollars.

Again, I want to welcome you and wish you every success in the meeting, and a pleasant visit to our country.

WHAT IS SOCIETY'S RETURN ON ITS INVESTMENT?
(TRANSPORTATION IS NOT AN END IN ITSELF)

Charles D. Baker
Chairman
Harbridge House, Inc.
Boston, Massachusetts

It is with considerable pleasure that I speak to you today, because I think in fact what we are about in this symposium is in some measure a watershed endeavor. Clearly all of us have at one time or another been engaged in considering matters relating to measurement of transportation performance. But for a variety of reasons, of which I will speak more in a moment, I think we are addressing this matter at least with a higher degree of urgency and perhaps are really addressing it somewhat differently than symposiums of this sort have done before. But before going into some details, a bit of historical review is in order.

By almost any measure, transportation has got to be viewed as one of the great success stories of the twentieth century. As we consider problems facing transportation, and indeed problems that at times are caused by transportation, it is well that we remember the overall performance that transportation systems have provided society at large. People in the Western world enjoy a measure of mobility undreamed of a few decades ago. Trade and general economic development goes on at a level that would be impossible without our transportation systems. Our many and several governments have surely all enjoyed their failures, but, on balance, the past record can only be adjudged as good. In short, we are not collected here to engage in castigation of the past, but rather to set about making major contributions to transportation in the future.

But I remarked that we were faced with a measure of urgency, and perhaps were truly at something of a watershed as we address this subject of transportation performance. The reasons for this increasing pressure are not hard to identify. Within the short space of ten years, we have suddenly come face to face with major issues of energy cost and supply, and energy is the lifeblood of transportation. We have for a decade and half or more recognized the importance of safety as it relates to transportation, but now, particularly with regard to the highway mode, we are concerned that our efforts are not achieving what we expected. In 1969 environmental legislation was passed in this country and similar legislation has been enacted in other places around the world. Thus, here again, the last ten years have brought us face to face with a major point of transportation-related concern. The relationship of transporation to economic development has been a subject widely discussed for a century, but the nature of that relationship and what in fact is actually occurring has commenced to get increasing attention in recent years. As our cities and their transportation systems suffer both operating and financial stress, our attention is inexorably drawn to the question of urban form and

transportation. Thus, in 1981 all of us accept without question that these are subjects which not only must be examined in detail, but must be examined with ruthless discipline, casting out the mythologies and replacing them with as much hard fact as we can assemble.

But some would ask, "With the immediate problems facing our various governments--ranging from disarray in the automotive industry to deteriorating infrastructure and financial stress among certain operating modes--are we perhaps, in our seemingly academic discussions here, engaged somewhat in rearranging the deck chairs on the Titanic?"

In 1833 General Karl Von Clausewitz' opus Vom Krieg was published. This has been viewed by many as the definitive work on war. Among the points the Prussian general made was that tactics and strategy are different, but failure to adequately pursue either surely results in dismal ends. The immediate transportation problems faced by any number of countries frequently call for quick, tactical response for their resolution. But it is imperative that at the same time, we do not ignore the work required for the formulation of basic strategies. In short, what we are here to talk about is surely different than addressing the current plight of certain aspects of transportation, but it is at least as important and can well lead to measures of knowledge and understanding which will ensure that transportation in the future will well serve society's ends.

That, of course, is the touchstone for all our concerns. What kind of return in terms of realization of society's goals do our transportation systems give us for the investment that society makes, be that investment in the form of government action, marketplace activity, or community response? If we regard this as something of a schematic with the investment by society in one form or another leading to certain kinds of transportation systems, what we, at this juncture, wish to know is how well we can measure the return or the results, if you will, with regard to safety, to environment, to energy, to urban form, and to economic development that these transportation systems give us.

It is useful here to note that improving our ability to measure such performance is equally important to us all, regardless of our particular ideological bent. If you share my personal bias towards the marketplace, you will quickly agree that the marketplace will be greatly improved by increased understanding and grasp of performance. If, on the other hand, your inclinations are rather more towards governmental intervention, it certainly follows that improved measures of performance should surely enhance any government's ability to act wisely. In sum, this symposium, if successful, will patently be useful to us all. The basic purpose of our gathering here is to exchange information and increase our individual and our collective understanding of what we know; what seems to work in the way of measurement and what does not; what perhaps we might do to improve our grasp and understanding; and what we can set for ourselves as a future agenda for examination, exploration, and international cooperation.

However, our task is no small one. As a starter one could ask why we selected these five subject areas and not a dozen others, to which the answer, in all honesty, is that there are surely other areas well worth our

consideration, but these appear to be amongst those ranking highest in our collective concern. But let's go further.

Ours is no academic challenge. On the contrary, our aim is to improve greatly our ability to dispel the mythologies and to enhance our ability to measure the performance of our transportation systems in the context of the goals of our society. The latter makes the challenge all the greater as the goals change within countries over time and, indeed, between countries. In the late 1940s and 1950s in this country, the single-family home ownership, and for that matter, automobile ownership, was certainly regarded as highly desirable goals for society and much was done to aim us in that direction. The programs of the Federal Housing Administration were supplemented by the Veterans Administration loan programs for home ownership, and these, along with other governmental policies, exploded single-family home ownership, and we saw a concurrent escalation in the ownership of automobiles. On the other hand, certain policies in Sweden of late have been predicated on the goal of reduction in the drive toward single-family home ownership and automobile ownership and operation. Clearly our concern is measuring the relationship between transportation systems and the goals of our society.

I implied earlier that we were less engaged in support of problem-solving and tactics than in things that would lead to strategies both in the marketplace and for governments. However, it should be noted that much of what we do can and should be related to improving the workings in the marketplace and the execution of programs that we have in hand. Thus, success at this symposium can enhance the near-at-hand as well as the long-range, but, as I implied above, the urgency and the importance of what we are up to can probably not be over-estimated. The energy crisis--less than a decade old--has driven home to all of us the need to ensure that marketplaces really work, that government policies really are effective in terms of what we wish them to do. In short, we have been forced to realize that which we should have long recognized, namely, that society should get a real return on its investment, whatever that investment may be, and its resources should not be squandered.

At the same time, we have become increasingly aware that special interests and the ability to stop but not build is simply a manifestation of a concern that much of what we do with regard to society, in general, and transportation, in particular, is not in fact producing necessarily what we expect or want. The more we can improve our understanding of what transportation system performance really is, the less we leave our societies open to uninformed and obstructionist mob rule or--an equal evil--an incompetent bureaucratic tyranny.

It is fair to ask why our symposium seems less concerned with assessing the inputs, be they from the marketplace, from government, or from community, than with the outputs--the performance. The honest answer is, of course, that society is concerned with all and so are we. But in this symposium our aim is more focused and direct. To what extent can we well measure the results and impacts of our transportation systems? If we can improve our ability to do that, it follows that we will, as societies, be better able to assess the worth and, indeed, the practicality of achieving certain ends in terms of what

is required of society to achieve them. But can we in fact measure the performance? A great deal of evidence suggests that, at best, we do this poorly. But in fairness to we transportationists, our failings are not unique.

A simple illustration serves to make the point. When I was rather younger, I spent several years in the U.S. Navy, and from time to time I was subjected to something known as a Naval Officers Fitness Report. This was a process whereby my performance as a naval officer was evaluated. But upon closer examination, the report really had little bearing on what the Navy paid me to do. There was nothing that said whether or not I caused the electronics in our aircraft to work better or worse than would have been the case without me. Rather, the report attempted to rate things that could be judged with come consistency, which somebody had concluded along the way ought to lead to my doing a good job, whatever that job might be. Thus, I was adjudged upon such intangibles as leadership, appearance, and other splendid items. Altogether too often in transportation we have great difficulty articulating what it is we really want the system to do, and thus, we fall back on measuring ridership, or ton-miles, or such abstractions as mean time between overhaul. But even assuming that we can identify the results we wish to see, as opposed to measurement of things that we believe will lead to results, how confident are we of the nexus between the transportation system and those results? Is the transportation system in fact the driving variable? I recall a dozen or so years ago, when I was employed by the Department of Transporation, talking with a high official in the Federal Aviation Administration. He declared, without qualification, that there were all sorts of straight-line correlations between economic development and the construction of airports in rural locations. As the months went by and I listened to his declarations, I became increasingly convinced that such relationships might exist or they might not, but that the chap in question had little, if any, hard information to back up his assertion, let alone engage in any meaningful measures of result.

Energy is of concern to us all, and conservation of energy is presumably a general goal. Not long ago, Dr. Altshuler of MIT raised some serious questions about the considerable use of energy involved in constructed, fixed guideway transit systems. Looking at it that way puts a rather new perspective on public transit.

At this point, let us spend a minute on some of the more particular problems that we encounter as we attempt to measure performance of our transportation systems.

In his excellent paper, which will be discussed during this symposium, Dr. Knoflacher makes some fascinating points. For example, he observes that town planning and highway construction have tended to rely on assumptions with regard to human behavior that in fact have rarely been tested and frequently prove invalid. He observes that this occurs because those involved come from technical backgrounds and do not have the requisite understanding. Thus, the performance is not what we expect, but worse, we at times refuse to accept the failure. On the other hand, these problems can be dealt with, at times quite exotically as represented by the series of equations dealing with time and distance and presumed behavior that are found within Dr. Knoflacher's paper.

But this underscores the fact that it takes a certain amount of courage to genuinely assess what is going on and to identify performance failures as well as performance successes. A dozen years ago Pat Moynihan observed to me that social scientists, to a large extent, and government policy-makers, almost without exception, had great difficulty accepting negative findings. This is hardly surprising, for as people work hard developing notions, and policies, and strategies, the idea of failure, and thus withdrawal or redirection comes hard. In short, true performance measurement is a discipline that few in society truly enjoy, and transportationists are no exception.

But this symposium must grapple with yet another problem. We speak of the transportation system, but what do we mean? When we have tried to measure performance at all, we have tended to measure specific modes or, even more likely, specific policies or programs dealing with specific modes. But there are those who would argue that the system with which we are concerned is rather more broad. The Department of Transportation in some of its studies over the last several years has attempted to take a somewhat multimodal view and break up the systems that we attempt to measure into local, intercity, and international, again dividing each of the three principals into passenger and freight. Is this in fact the way we should attempt to go about measuring performance? Should we do it by identifying the system and then measuring its performance with regard to certain of our goals, rather than attempting to assess the specific results that may be related to narrowly defined policies or programs or activities in the marketplace? Many of those connected with the development of this symposium are arguing that is precisely what we should do, notwithstanding the fact that historically that is almost exactly what we have never done.

Another problem to which I briefly alluded earlier relates to what it is we are measuring. Certainly if the measurements are not related to the goals and concerns of society, the measures of performance are inherently of no value, but there may well be disagreement upon the goals or the relative importance among them. A couple of years ago Lord Rothschild wrote a book that had to do with deciding what was and what was not significant. He raised some fascinating questions with regard to the subject of safety, including the oft-discussed "carnage on the highways." He suggested that perhaps the carnage so readily seen by many was perhaps less real than had been supposed.

Another kind of difficulty we encounter is whether we are measuring for efficiency or effectiveness. In Mr. David Hartgen's excellent paper, he comments that the performance of the system is determined by how well it executes the functions expected of it. Thus, if a transit system is expected to run trains over various layouts, our measurement might well be oriented towards questions of efficiency. Does it perform its functions with minimum cost? Are the cars kept clean and do they run on time? On the other hand, if one interprets "the functions expected of it" to mean carrying vast numbers of riders or--even more difficult--significantly alleviating automotive congestion, we get into matters of effectiveness and we discover that measurement is more difficult and, not surprisingly, more open to dispute. Perhaps my Naval Officers Fitness Report is a useful analogy. It would appear that I was being evaluated for efficiency rather more than for effectiveness.

Surely the identification of what it is we really want to measure the system for is no easy task. Since it is always easier to speak with question about someone who is not here, let me surface a couple of aviation examples. During the early 1960s our Department of Defense decided that it would produce a fighter aircraft of common use for both the Air Force and the Navy. Presumably this endeavor had a number of goals, including effectiveness of the aircraft as a combat vehicle and, through commonality of usage between the Air Force and the Navy, significantly reduced cost. The longer the program continued, the more it appeared that costs were going to be significantly larger than expected and performance in a combat sense was going to be somewhat short of expectation. However, the shelves are filled with analyses designed to suport the logic of the already-committed endeavor.

Development of a supersonic transport was launched in the late 1950s in both Europe and the United States. The goals of such endeavor were argued to be many and several, but ultimately seemed to boil down to the notion that flying faster and higher was inherently a good thing. After ten years or so of effort and expenditure of approximately half the development budget, the United States suddenly did an about-face and canceled the program. The English and the French, on the other hand, plowed on and produced a technological masterpiece. But who would wish to defend the notion that serious performance measurement was ever ruthlessly pursued on either side of the Atlantic? My question is obviously rhetorical.

The BART system in San Francisco was launched with great public relations in the late 1950s. Reading the literature over the years would lead one to conclude that measuring the performance of this modal-parochial system would be hard to do because the goals of the system in the form of claimed benefits seemed to change from time to time. In the same sense our inland waterway projects are required by law to engage in cost-benefit analysis. Leaving aside the cost part of the equation, this requires a forecast of the anticipated performance of the "system" when fully operative. The size of the debate that takes place with regard to these analyses suggests little agreement on either what the benefits are or the measurements applied to them.

Sometime back the French government embarked on a policy of developing six principal cities. It was concluded that transportation would play a major role in such development. The state of play of the six-city development policy is somewhat unclear to me at this juncture, and it is even less clear about the present views on the relationship of transportation to the program.

During the 1960s in Germany, policies were launched designed to place economic penalties on motor haulage with the aim of improving the volume of traffic going by rail. Impact of the particular policy apparently was somewhat limited, but in terms of our symposium, such things present difficulty when one is attempting to assess the performance of the intercity surface freight systems.

In 1965 the U.S. Government concluded that killing 50,000 people annually on the nation's highways was too many. As a result, legislation was enacted and federal intervention was undertaken in the form of regulatory programs.

Today, fifteen years later, we kill about the same number of people on the nation's highways as we did in 1965, in fact a shade more. Does our performance measurement thus suggest that the highway mode is performing poorly, or do we look at intercity passenger transportation as an aggregation and conclude that--since bus, commercial air, and passenger rail are "safe" by almost any measure--performance of this transportation is essentially "not any worse than it was"?

Other problems confront us as well. At times there may well be a consensus on what it is we are measuring for, but a total lack of data to construct the measures. Transit ridership may be critical in our analyses. On the other hand, much of what we might like to know is very hard to come by. Passenger miles are simply not recorded as they are with air transportation. Passenger profiles are either assumed or dealt with by various kinds of sampling.

The more we get into our performance measurement, the more we realize that energy is not necessarily energy. In the main, our measurement of the performance of transportation systems with regard to energy is mostly oriented towards measuring the system's consumption as opposed to the impact of the system on some desirable end like economic development. But is energy consumption where oil is being consumed the same as when the source is coal? What is it we are trying to measure, and how does "this" relate to the goals of society?

Some other problems arise as we attempt to measure the performance of our systems, and one of those is timing. To the extent our measurements relate to things of near concern such as activities in the marketplace, currency is a virtue and not a curse. But to the extent we are also looking to use our findings for matters farther out, it is important that we consider how our findings of today will inevitably change tomorrow as technology revises matters, as demographics are altered, and indeed it is the very things we wish to measure for in terms of aims, and goals may vary over time.

In several countries, the operation of the nation's rail system has been to a large extent an instrument of social policy. Passenger transportation have been priced at measures artificially low. Employment has been maintained at levels artificially high. As we attempt to measure transportation system performance, how do we go about shredding out the purely social aspects from the actual transportation aspects? How do we deal with that international phenomenon--occurring in every country on every continent--that builds in a measure of protectionism and endorsement on those transportation systems that are owned and operated by the public sector?

At the outset I remarked that this symposium might well prove to be something of a watershed as we collectively attempt to significantly improve our ability to decide what our transportation systems are really doing and what we think of such results. It seems to me that if we can come to grips with certain kinds of questions in the course of these three days, we will have advanced our cause greatly.

What are we talking about when we refer to the transportation systems? Historically we have dealt with parochial modes or even more narrowly focused programs related to them. Do we in fact define our transportation systems in useful ways so that we can measure their overall impact? And in so doing, will we be sufficiently inclusive so that we consider matters of the infrastructure and its construction, as well as equipment and operations? The energy performance of a system in place is dramatically different than a system projected.

What is it for which we wish to measure? If we continue to look at measurement in narrow program senses, we can, of course, continue to measure for narrow program results, all the while, of course, ignoring entirely the larger aspects of the overall system performance within our several broad subject areas, let alone as between them.

As we attempt to measure the transportation system's performance with regard to economic development, how will we define and measure economic development and how will we confirm the nexus between the system and the perceived result?

In the course of our measurement, can we satisfactorily identify what appear to be the key variables in the system, so that we can then go on and do something with our findings? Are we concerned with cars or buses, or high- or low-mileage cars, or is occupancy and load factor the issue? In short, if we do measure the system's performance, what light can we shed upon "why"?

I remarked briefly on some of the constraints we may face in data. What can we do with regard to both availability and timeliness? Can we achieve the measurement tools that we need without unnecessary cost or disruption?

In the course of these three days we will be examining five critically important subject areas. We are fortunate to have as participants, be they authors, or panelists, or moderators, a gathering of some of the most distinguished and expert persons concerned with transportation and society.

In each of the subject areas we will be initially examining what is presently going on. What practices are presently being pursued and what success are we enjoying in terms of our ability to truly measure the performance of our various transportation systems? And equally important, where are we failing?

The second series of workshops will build upon the first and will focus more on the topic of "what might be." Looking at what appears to be useful in present practice and what is not, the questions then arise as to what it is we ought to try and do in terms of measuring performance and what requirements these put before us.

In the third of the sessions, the workshops will to some extent be engaged in summing up. What does this present to us in terms of an agenda for further research, or agenda for experimentation in new places, in terms of discarding old mythologies and now-disproven shibboleths.

Certainly this symposium will educate us all and for many of us will imply new strategies for government action, be it interventionist in nature or significantly more oriented towards facilitating the effective play of the marketplace.

Eighteen months ago, in some remarks I made at Princeton, I observed that contrary to the conventional wisdom in the Washington Post, we had long had in this country a fairly detailed national transportation policy and it was there for anyone to see who really wanted to look. The problem, of course, was that such policy was frequently more implicit than explicit, but it was nonetheless quite rigidly followed. Probably the most significant aspect of such policy was something to the effect that transportation is inherently a good thing and that more transportation is inherently a better thing. And finally, that if demand, or at least perceived demand, for transportation was not being responded to by the private sector, it was the proper role of government to enter into the proceedings. I went on to add that such policy, virtually intact for a hundred years or so, had in the last decade undergone serious challenge. Today, policy both explicit and implicit accepts the notion that transportation and transportation systems may be good, but the burden is upon us all to ensure that they really are delivering what society wants; in short, that they really are performing, which means that we, like society at large, when it comes to transportation systems, are fundamentally wrestling with the question:

> What is the impact of transportation with regard to energy? With regard to safety? With regard to economic development? With regard to the shape of our cities? With regard to our environment? What do we think of that impact?

My friend, Professor George Wilson of Indiana University, wrote to me not long ago with regard to a recent book of his which he described as "a very negative book saying that we really don't know much about this industry despite over 100 years of effort." However, he went on to remark that Gunnar Myrdal used to say that telling people that what they think is true is not necessarily true, is a species of scientific advance.

This symposium has a tremendous opportunity for scientific advance. Indeed, one might say ballistically that it has a double-barreled opportunity, for we can and will bring forth a great deal about what we don't know, but we also can and will identify what we do know, what has worked, and indeed where we logically go from here. It is surely not an overstatement to say that in these three days, we can bring forth a level of understanding and an agenda for the future and thus will very directly impact on the societies in which we all live.

THE NATIONAL TRANSPORTATION SYSTEM AND THE U.S. ECONOMY

Edwin L. Harper
Deputy Director
Office of Management and Budget
Executive Office of the President
Washington, D.C.

Introductory Remarks

It is a pleasure to be invited to address such a distinguished gathering.

My staff tells me that many of the most recognized experts on transportation are participating in this conference.

In particular, I would like to extend a welcome to the participants and observers from the European Conference of Ministers of Transport and the Organization for Economic Cooperation and Development. I am sure that the exchange of ideas occurring at this symposium will benefit all of us. I hope my remarks will satisfy your curiosity or, at least, contribute to your understanding of what many of you may consider a "peculiarly American" approach to transportation issues.

For both the foreign visitors and the American participants and observers, I hope my remarks help you to understand the philosophical and conceptual underpinnings of the Administration's policies generally as they relate to and shape transportation policies.

In addition, I hope to be convincing to the American participants, because, after all, that is partly why I'm here. Since I do not intend to imply that our approach is necessarily right for other countries, I only intend to be provocative and interesting for our foreign visitors. I hope I do not provoke the Americans while convincing the Europeans.

Before beginning, let me briefly outline the three topics I intend to discuss so you can follow with me as I progress through my speech.

First, I think it would be useful and interesting to everyone to discuss the role of the Office of Management and Budget -- OMB, as it is commonly called -- because OMB's work is really intimately related to the subject of your Symposium.

Second, I want to touch briefly on the overall economic situation facing this country and the President's program for economic recovery because one cannot fully grasp the necessity of changes in our transportation policies without understanding the need for fiscal restraint.

Third, I would like to mention four illustrative examples of how we evaluated the effectiveness of transportation programs. In so doing, I intend to demonstrate that OMB has attempted to review transportation programs with an eye toward their contribution to surface transportation system performance.

At the end of my speech I hope I can leave you with two things:

1. a sense of the overall economic picture in which transportation plays an important part, but only a part, and

2. the intellectual process by which OMB evaluated particular programs--a process which is dependent in many ways on the progress you make improving our capability to evaluate surface transportation system performance.

The Role of OMB

OMB has a peculiar reputation among those who deal with us and those who otherwise keep up regularly with what is happening in Washington.

Among others in this country, OMB has little or no reputation, good or bad, except its past and present associations with two of its most recent and famous--or infamous depending on your point of view--directors, Bert Lance and David Stockman.

Our peculiar reputation among Washington insiders is a two-sided coin. Instinctively, they usually refer to us by using evil words. When they wish to be more flattering, they refer to us as the "elite" of the bureaucracy.

While our technical competence and performance in a highly pressured environment is seldom questioned, I can tell you from experience that our substantive judgments are almost always questioned.

Our job at OMB is, simply put, to look out for the President's interests; to be his eyes and ears, and strong arm if necessary. Sometimes this means being a place for brokering disagreements among different agencies or coordinating the Executive Branch's dealings with Congress. Sometimes this means giving a second opinion to that of the Department or being the devil's advocate so that the President can have a real choice between real options. OMB's job always includes seeing to it that the President's policies are carried out once his decision is made.

Others in the Executive Office of the President and the White House staff have the same function; indeed, I serve as an assistant to the President in addition to my role as OMB's Deputy Director and can vouch for that fact.

But none of the White House organizations can match the capability of OMB for comprehensive, detailed, day-to-day oversight of the actions of the entire Executive Branch.

One of our first tasks upon taking office in January 1981 was to figure out a way to reduce Federal spending. I should say that this was indeed our first task since we started doing this well before January 20.

I'll describe some illustrative details of that review later in my speech, but I wanted to point out that OMB's review was largely based on our assessment of the effectiveness and efficiency of various programs and the appropriateness of those programs in a Federal system.

I believe that this type of performance-oriented review would be very familiar to many of you at this symposium since it depends, in essence, on the state-of-the-art you discussed in the last few days for measuring surface transportation system performance.

The literature developed by analysts such as you did affect our judgments--sometimes directly, more often than not, indirectly.

I will not pretend that our analysis of Federal programs was as thorough as a PhD dissertation--work at this level of government with the time constraints, the inherent uncertainties, and the need to work at a macro-level of detail can seldom be exhaustive, comprehensive or conclusive.

Nevertheless, OMB's work is influenced by your contributions to the literature.

Of course, you will be glad to know that the usual author's disclaimer in the literature is accepted by OMB--any of our error's must be our fault and not yours.

The Economic Predicament and the President's Program

Let me briefly review the economic picture that confronted the President when he came into office:

- A 2.7% annual inflation rate during the 1960's had risen to 7.8% in the 1970s, and 13.4% from 1979 to 1980.
- For the first time since World War I, we have experienced two years in a row of double-digit inflation.
- Economic growth has gone down. Real GNP annual increases in the 1960s had averaged 4.2%; in the 1970s real growth averaged only 8.1%, and it actually declined from 1979 to 1980 by one-tenth of 1%.
- Productivity has actually fallen over the last three years.
- Interest rates have gone as high as 20% and some home mortgage loans now exceed 15%.

I will translate the statistics into more personal terms and look at the staggering effects:

- Less than 7% of American families qualify for a $60,000 home mortgage at a 15% interest rate.

- If inflation continues at 13% a year, a car that cost $7,000 now will cost more than $11,000 in 1982.

- On a more day-to-day basis, in 1985 a 38¢ cup of coffee will cost 63¢.

Everyone is hurt by the vicious stag flation that grips our economy. Eight million people are out of work. For those who have jobs, real hourly wages have fallen 5% since 1976, and average family taxes are up 67% in the last five years.

The basic premise of this Administration is that the most important cause of our economic problems has been the government itself.

The Federal Government in the past has sacrificed long-term growth and price stability for short term gains through tax increases, excessive spending, regulatory restrictions and overly accommodative monetary policies.

The result inflation, haphazard and inefficient regulation and high marginal tax rates have:

- reduced economic growth;

- lowered productivity; and

- discouraged work, innovation and investment.

The President's program is designed to spur economic recovery by four interrelated remedies:

1. by reducing Federal spending;

2. by cutting taxes;

3. by providing regulatory relief; and

4. by encouraging monetary stability.

For our purposes this afternoon I am going to concentrate on the first remedy--budget cuts--but I want to emphasize that all four remedies are necessary. However, by discussing the spending cuts I think I can bring you a better sense of the role of OMB and our efforts to evaluate the effectiveness of Federal programs.

Measuring the Effectiveness of Four Transportation Programs

I have chosen four transportation programs to illustrate in some detail the intellectual judgments OMB made in recommending budget reductions in the surface transportation area.

The four are: Amtrak, Conrail, Mass Transit, and Highway Safety Grants.

I have chosen these four because together they touch on the five topics you are discussing at this symposium: energy, economic development, the environment, urban form, and safety.

As I review these four programs you should keep in mind the philosophic bases that this Administration used to guide its thinking.

The first question we asked was: is this something that the private sector could do better? Should we let the free market work unhindered?

If we needed to "tinker" with the market place, the next question we asked was: could the externalities such as energy-use, the environment and safety be internalized in a less intrusive, efficient way than direct government intervention?

If the government had to be more involved, the third question we asked was what level of government--Federal, State or local--should be in charge? In our country, and in some others, the responsibilities of government can be divided among these different entities. One of the basic precepts of the Reagan Administration is that the Federal Government has intruded unnecessarily and inefficiently on what should be the domain of State and local governments.

If the Federal Government has to be involved, the fourth question we asked was whether or not the services provided could be paid for by user fees in whole or in part. Such user fees would distribute the costs of government service more equitably and efficiently among those who benefit. Furthermore, it would lower the crushing general tax burden being placed on the people at large.

Amtrak

Let me share with you some of the facts that we discovered when examining the contributions Amtrak makes to our national transportation system.

Passengers pay only 40% of Amtrak operating costs. On many routes the average ticket subsidy is $60-70 per person. The subsidy reaches as much as $192 per ticket on the Sunset Limited (New Orleans to Los Angeles). It would be cheaper for the government to give someone an airline ticket from Washington, D.C., to Cincinnati than to subsidize their Amtrak ticket.

In comparison, the average Federal subsidy for other common carriers in 1978 was 1¢ per bus passenger, 75¢ per commercial aviation passenger and $37 per Amtrak passenger.

Between 1972 and 1980 Amtrak's annual operating deficit rose from $153 million to $657 million.

Amtrak revenues now cover only 33% of its total costs (including capital costs). The passenger rail system in the United Kingom covers approximately 70% of costs; Denmark, 50%; and the Netherlands, 50%.

At current train load factors Amtrak provides 48 passenger-miles per gallon of fuel. In comparison, intercity buses provide 135 passenger-miles per gallon. A new automobile carrying the driver and one passenger would equal Amtrak's fuel efficiency if it obtains only 24 miles per gallon in highway driving. Many new automobiles exceed this mileage rating.

Even if Amtrak filled every train 100% with passengers and all those passengers came from automobiles, the gasoline savings would be only two-tenths of 1% of the current gasoline consumption of automobiles.

Train travel represents less than nine-tenths of 1% of intercity travel. In areas other than the Northeast Corridor (Boston to Washington) and possibly a few other short distance routes, Amtrak service is simply not essential to the nation's passenger travel market.

I think some of you might agree with me that given these facts, our proposed reduction in the Amtrak budget was a natural target. The costs of Amtrak to the taxpayer are excessive, the energy savings are minimal, and the impact on national intercity travel almost nonexistent.

Conrail

Conrail presents the Federal Government with primarily a regional transportation problem. Solving this problem depends on finding a way to continue vital rail services in the Northeast region of the country without continuing to subsidize inefficient and wasteful operations of Conrail. With this goal in mind, the Administration has based its proposal to sell Conrail's lines to other rail operators on the following key facts:

- The Federal Government has already provided $5.7 billion to Conrail, its employees and its stockholders since 1976. An additonal $435 million is contained in the revised Reagan budget for a total of $6.1 billion of Federal assistance.

- In comparison, the estimated total cost to the Federal Government when Conrail was formed in 1976 was only $2.3 billion.

- Conrail itself estimates that an additional $2.4 billion would be required over the next five years to maintain the status quo.

In face of these dramatic subsidy needs, just how crucial is the maintenance of Conrail as a corporate entity to the Northeast region? The answer is, in a nutshell, not very.

A recent analysis by the United States Railway Association (USRA)--Conrail's Banker--estimated that 80% of Conrail's present traffic would be sold to other railroads in the region if there were a simple auction sale of Conrail lines.

Of the 825,000 carloads of traffic not transferred under this analysis, more than one-half may be located in clusters of sufficient density to attract other rail operators, such as short line railroads.

USRA performed an additional analysis which measured the "need" for rail service by comparing the costs to the shipper for rail service compared with the costs of substitute truck service. I understand Professor Paul Roberts of Massachusetts Institute of Technology (MIT), one of your panel moderators, assisted in this study, so perhaps he can correct me or add some additional comments. To be on the safe side since Professor Roberts is here, let me quote, directly, the USRA conclusions from this study:

> Thus, it would appear that tough rail service is important to a high proportion of traffic in the Northeast and Midwest regions served by Conrail, very little of it would be forced to shift to a less economic mode under any of the options examined in this report. Even without making a final choice among the alternatives at this point, it is clear that a private sector solution to meeting the transportation needs of the region is possible.

For those few shippers and communities which might be hurt by the transfer of Conrail to other railroads, the USRA report concluded that "regional economic impacts are minimal over time, and that it is possible for even communities and individual firms to suffer little sharp and lasting disruption when rail lines are abandoned."

I should note in concluding this section on Conrail, that the Administration's proposal for the transfer of Conrail lines to other railroads requires more than the simple auction of profitable routes. Some of the bad and the good traffic might be packaged together so that over 90% of the traffic--instead of 80% under USRA's scenario--would be picked up by other healthier railroads.

Through this sales process, it is our expectation that shippers in the region will receive better and more stable rail service. I might note that two shipper groups, the National Industrial Traffic League and the Farm Bureau, are supporting the Administration's proposal for this reason.

Mass Transit

Our efforts to evaluate mass transit programs ran into a number of interesting facts that put mass transit in a somewhat different light than

most people assume. For instance, what role does mass transit play in urban transportation?

According to U.S. Census Bureau surveys from 1970 to 1975, public transit's share of the home-to-work travel market decreased from 8.9% to 6.0%. Not only did its share of the market decline by 33%, in absolute numbers those workers using transit declined 29%.

Transit industry ridership figures for 1979 show approximately a 16% increase over 1975 levels. Assuming a growth rate in the base workforce over the same time of 11.1%, transit's share of the market increased only slightly to about 6.25%.

The congressionally-sponsored National Transportation Policy Study Commission predicted that from 1975 to the year 2000 only 6.5% to 7.5% of all urban trips would be by transit.

What is the distribution of government subsidies to transit? Although mass transit riders tend to have lower than median incomes as a group, government subsidies tend to flow to the more affluent riders. Let me follow this logic in more detail:

All analysts agree that the most unprofitable mass transit routes are those that serve the long distance, suburban, home-to-work commuter. The continuation and expansion of these routes with fares that recover only a fraction of the cost places an even greater burden on the poorer inner city resident.

The inner city routes tend to have higher ridership, higher vehicle utilization rates and, consequently, lower costs per passenger trip. Inner city routes already form the core of mass transit service. A GAO study of one transit system's cost structure found that the subsidy per passenger for inner city, local bus service was 73¢ per trip compared to $2.91 for express bus service to the outlying suburbs.

The reduction of Federal assistance for operating subsidies and building new subways should affect inner city transit service relatively little. Service expansion is generally not necessary in the inner city; service cutbacks would be directed at money losing suburban routes; and fare increases would be less necessary for inner city routes since they already cover a higher percentage of costs.

Transit subsidies for operating and capital costs are simply not very efficient forms of assistance to the poor. Especially rapid rail and commuter rail system subidies goes to low proportions of poor households. An estimate made in Alan Altshuler's recent book on urban transporation to reflect the benefits of transit subsidies by income level concluded that only 22% of such subsidies went to those below the poverty level.

Does mass transit save energy? As energy savers, the benefits of constructing new rail systems do not seem to be worth the tremendous cost.

The five fixed rail systems currently under construction will cost an average of 75 million dollars a mile to construct and equip for operation.

As the nation's car fleet become more fuel efficient, the pay back period to recover the initial energy costs of construction assume very long periods. One estimate by Charles Lave for BART assumed it would never repay its initial energy investment, which amounted to 44% of the total energy it would use during construction and 50 years of operation.

Even assuming that Lave's calculations are wrong, compared to other possible uses of the money to save energy, building new rail systems is not very cost effective and does not do much at all for us in the near future when our energy dependency is greatest.

A doubling of transit capacity during the 1980s would save only 27,000 to 43,000 barrels a day of oil according to the CBO, which amounts to only about two-tenths of 1% of our national daily consumption.

Will transit effect the development of what your symposium terms "urban form"? While one cannot deny that massive fixed rail systems may lead rather than follow the development of dense urban corridors, some skeptical observations can still be made.

Is the development of dense urban corridors with high rise apartments and condominums a good thing? Clearly it is not in the minds of many communities. But if such development is not allowed to occur, will the new transit line achieve the ridership figures used to justify its construction?

Can massive transit investments really reverse or significantly mitigate the effects of the declining density of American urban areas of all sizes? Are the transportation needs of our urban residents really being served by massive capital and operating subsidies for fixed route scheduled transit service that may not be able to adapt to changing demographic patterns?

Shouldn't we look more closely at less traditional paratransit alternatives such as carpools and vanpools that may provide a more appropriate service to the more urban area?

Highway Safety Grants

One of the most difficult tasks facing OMB is how we review the budgets of Federal safety programs. Recommending a reduction in funding for a safety program to the President sometimes feels like telling your minister, priest or rabbi that you are reducing your contribution to the church because you don't see any evidence that enough souls are being saved with your money.

Since your program deals with the topic of safety, I thought I'd give it our best shot--a budget reduction for a small, but ineffective program known as the highway safety grant program. The facts on which we based our recommendation are:

- Since 1966, the Federal Government has contributed nearly $1.3 billion under this program.

- This represents only 2% to 3% of the total State and local funds spent on highway safety.

- A recent GAO study of this program concluded:

  (1) The National Highway Traffic Safety Administration (NHTSA) and the safety agencies still do not have, after 13 years, the necessary capability to conduct many evaluations under the the safety grant program.

  (2) NHTSA does not effectively disseminate what evaluation information it does have among all States.

  (3) Federal research efforts have, for the most part, been useless in helping State and local governments select successful highway safety projects.

  (4) Thus, safety agencies continue to implement a wide range of projects without knowing which have been successful or unsuccessful in reducing accidents.

Until NHTSA takes the lead and develops a credible and organized evaluation program to determine which countermeasures work or do not work and establishes a method for disseminating and using that information, the safety program's effectiveness will likely remain unknown. NHTSA plans to devote more resources to this area, but we were told that its plans may be hampered by funding limitations.

As you see, the minister is asking for more money. Should we give it to him?

GAO itself discussed the alternative of refusing more money and ending the program. I am pleased to quote GAO:

> Safety grant funds continue to grow, with little or no assurance that more money is the answer. The 2 or 3-percent funding that this program represents does not seem to be large enough to have any significant, measurable impact on overall accident reductions. Moreover, the program may have already served its purpose by establishing safety standards, data collection/analysis systems, and State safety agencies. Those safety activities that the State and local governments ... are already supporting with their own funds will likely continue....

In times of budget austerity, it just makes no sense that we continue a program of no proven effectiveness, even if it is related to safety. The Administration is proposing to continue only those key safety programs of known value: aid for alcohol safety research, police training, emergency medical services and traffic record keeping.

Conclusion

I hope my remarks this afternoon have proved interesting and perhaps even convincing to the Americans in the audience and provocative to the rest of our visitors.

I expect that none of you agree with everything I've said. Please don't quiz me too hard in your questions to follow on the statistical significance of my figures. I cannot compete with you at your game.

What I can do is demonstrate that in many ways what this symposium is about--the measurement of transportation system performance--is very similar to what OMB is about.

I wish you success in your endeavors to improve our capability to measure and evaluate the performance of our transportation systems, because our work at OMB for the President ultimately depends on your success.

Thank you.

SUMMARY REPORTS OF WORKSHOP SESSIONS

of the

International Symposium on
Surface Transportation System Performance
May 11-13, 1981

Prepared by

JEFFALYN JOHNSON AND ASSOCIATES, INC.
Falls Church, Virginia

ENERGY CONSERVATION AND THE TRANSPORTATION SYSTEM

Since the 1973 oil crisis, the need to conserve energy has become a major subject of concern for most of the industrialized world. The problem is marked by heavy dependence on imported oil, the rapid rise in oil prices, and the possibility, within the next 20-50 years, of exhaustion of world oil supplies. These have already affected social and economic life and pose a continuing threat to future well-being and progress. The threat is most acute in the transportation sector. Of all energy consumed in transportation, the average dependency on oil is 97.5% in Western Europe, 99.9% in North America. Two-thirds of this is attributable to road transport, with heavy concentration in private passenger vehicle usage. How the energy/transportation problem is being dealt with and what could or should be done constitute the central theme of this agenda topic. Although discussion moved freely from one such topic to another in the three workshops--State of the Art, Performance Indicators and Data Requirements, and Policy Issues and Implications--the report that follows reflects the major points made and concerns expressed as they relate to particular workshop objectives.

Energy Conservation and the Transportation System: The State of the Art

Panelists and Papers Presented

Bruce T. Barkley, Chief, Policy Planning Division, Federal Highway Administration, U.S. Department of Transportation, Washington, D.C.
"Evaluation of Energy and Transportation Performance"

Rudolf Gabler, Assistant Director, Office of Research and Development Policy and Transportation Technology, Federal Ministry of Transport, Bonn, Federal Republic of Germany
"Methods of Calculation Concerning Energy Consumption in the Field of Transport"

Jose Carlos Garcia-Hernandez, Delegate, Department of Traffic and Transport, Municipality of Madrid, Spain
"Energy Situation of Transportation Systems in Spain"
(Paper prepared in cooperation with Sebastian de la Rica Castedo, Director, Department of Traffic and Transport)

George A. Giannopoulus, Professor of Transportation Engineering, University of Salonica, Athens, Greece
"Energy Conservation in the Transport Sector: The European Experience"

Burkhard Horn, Principal Administrator, Road Research Program, Organization for Economic Cooperation and Development, Paris, France

Manuel Losada-Garcia, Director, RENFE, Madrid, Spain
"Efficiency of the Modes of Transport in the New Energy Situations: The Position of the Railway"

State of the Art

The objectives of this workshop were:

- to review and assess the effectiveness of measures being taken to promote energy conservation and
- to review and assess the validity and pertinence of current techniques for measuring and comparing energy consumption in different transportation modes.

Discussion in this and subsequent workshops clearly demonstrated that the target of the drive for energy efficiency is reduction in the use and energy consumption of the private passenger automobile. Aviation and maritime transport were mentioned briefly. Rail systems (freight, inter-city, and urban) were discussed partly in terms of improved efficiency, but chiefly as an alternative to private car use. There was no disagreement with the thesis that generally railways are highly efficient. But various participants noted that the efficiency rate depends heavily on distance and utilization of capacity, and that a rail system's acceptability as a substitute for the private car is not solely based on efficiency considerations.

Singly and through a variety of consultative arrangements, Western European governments have tried to confront the energy/private car problem through a number of approaches. These are:

- policy changes, such as reducing new road construction and emphasizing and improving the efficiency of freight and passenger rail systems. Significant strides in increasing rail efficiency have been made in West Germany and France through technological improvements, electrification, and speed in scheduling;
- regulatory measures, such as restrictions on vehicular traffic and fuel availability, and imposition and enforcement of speed limits;
- economic and financial incentives and disincentives, through pricing and taxing policy affecting vehicle purchase costs, and licensing and fuel costs. It was noted that in Western Europe vehicle purchase taxes ranged from 10% in Luxembourg to 33.3% in France to 150-300% (depending on car price) in Greece. Contractual arrangements to improve fuel efficiency and reduce consumption have also been undertaken with vehicle manufacturers, industry, and trucking organizations;
- research and development efforts directed mainly towards construction of more energy-efficient vehicles (reduced weight, new transmission systems) and production of alternative fuels;

- intensive public information and education campaigns to promote awareness of and interest in fuel efficiency and in ways to conserve fuel, such as greater use of carpools and vanpools.

Each of these approaches is being utilized in one country or another with varying degrees of success; but, they have yet to be employed in cohesive fashion. Moreover, while these approaches were generally accepted as relevant in the context of their objectives, some basic questions were raised in the course of discussion.

Several participants called attention to the confusion between energy efficiency and energy effectiveness and stressed that fuel savings must be examined in the perspective of other socioeconomic costs and benefits. Other comments were critical of the apparent tendency to rely on average aggregate values and on single-mode assessments and comparisons in determining modal efficiency and modal shift policy initiatives. For example, while accurate calculations of modal energy comsumption are possible, how do you calculate the energy costs of infrastructure? Similarly, to assert that rail is more efficient than the private vehicle is meaningless unless the statement takes into account the overall quality of service: time, speed, frequency, occupancy, comfort, and convenience.

The general sense of the discussion appeared to be that average value and single-mode approaches were useful only insofar as they provided a sense of the situation. They neglected inter-modal complexities, lacked precision and depth, did not provide the exactness of data required for accurate assessment, and lent themselves too easily to misinterpretation and faulty policy decisions.

Reviewing discussion on this topic, one participant expressed the opinion that the current state of the art was badly fragmented and that much work in this new field of research and analysis was still to be done. The hope was expressed that cybernetic models, such as the projected 500-variable, dynamic long-term computer model now being developed in Norway, would more clearly define the complex interaction and causal relations between the total transportation system and national economic and other community activity.

Energy Conservation and the Transportation System: Performance Indicators and Data Requirements

Panelists and Papers Presented

John J. Fearnsides, Director, Planning and Policy Studies, MITRE Corporation, McLean, Virginia

S. Olof Gunnarsson, Professor, Department of Traffic and Urban Planning, Chalmers University of Technology, Goteborg, Sweden
"Swedish Experience in Poolective Transport"

Wim Horn, Head, Study Department, Ministry of Transport and Public Works, The Hague, Netherlands
"Priorities in the Field of Energy Related to Transport"

Ilja Kordi, Chief Consultant, Prognoskonsult, Danderyd, Sweden
"Energy Efficiency in Transportation--Problems in Defining and Assessing Performance Indicators"

Roger Quarterman, Bureau of Transport Economics, Canberra City, Australia
"Australian Domestic Freight Transport--The System Energy Performance of Competing Modes"

Performance Indicators and Data Requirements

The objectives of this workshop were:

- to identify data gaps in available research and analysis and
- to suggest specific areas of further study.

The most obvious need, as reflected in the majority of the comments, is for more detailed, precise, systematic, and comprehensive data directly or indirectly affecting the energy/transport relationship. Too much of the information now available is too general and imprecise. One dissenter cautioned, however, that over-detailed statistics can prove misleading and may not be necessary, and that a more general overview is preferable.

General acceptance appeared to be given to the following: to the extent possible, data to be obtained should represent empirical, not theoretical, results and should take into account factors of time, distance, speed, frequency of service, peak and off-peak usage, load, utilization of capacity, etc. Measurable data should be emphasized, but with recognition of intangibles such as modal preferences and status. Analysis of the statistical and other information gathered must reflect differences in national, regional, and local conditions. There are no average or typical solutions. Micro-oriented, that is, site-specific and task-specific, studies are essential. It is possible that techniques adopted for detailed micro modes can be aggregated at the national level and the results translated for lower level use (a down-to-top, top-to-down approach). But accuracy and relevance require beginning at the bottom.

Several participants spoke to the need to identify and distinguish among the various types of energy costs in evaluating modal efficiency. Propulsion costs are only one consideration in assessing the efficiency of road transport. Construction and increasing maintenance costs can equal or exceed operating energy expenditures. Similarly, initiation or expansion of urban transit systems should factor into the cost-benefit equation the massive construction requirements for energy, not only the service costs.

The efficiency versus effectiveness issue drew support on both sides. One view held that a credible package of effectiveness indicators was

necessary and should be developed; this required precise, disaggregate data. The contending view asserted that effectiveness was difficult to evaluate, since it was distorted by other government policies; the focus should be on efficiency, which can be measured.

Further study on the behavior and attitudes of the public was strongly recommended. There is no denying that the affinity for the private car is as intense as ever. Partly, this derives from the comfort, convenience, freedom of mobility, and sense of status conferred by the automobile. Partly, it is based on misperceptions of the cost of private driving. Sharp increases in fuel prices over the past few years have dispelled some misunderstanding (and brought about some reduction in private car fuel consumption) but the true costs of the road transport system are still overlooked or are greatly underestimated by the public. How can tnese costs be impressed on public consciousness? Under what set of circumstances is mass transit not regarded as an "inferior good"?

In considering the question of costs and public perceptions, studies of the effects of a free unregulated market on fuel prices and consumption and on passenger car usage would be highly useful. Additional areas of study recommended include: the effects of a mushrooming telecommunications industry on transportation systems and ways to improve management of transportation programs.

A number of comments were addressed to the attitudinal approach of researchers. One urged that studies be undertaken in a non-emotive, objective manner. Another stressed that in democratic, decentralized societies researchers should bear in mind that the transportation system is not the property of planners and that people always find ways to get around the broad aims of policymakers.

Energy Conservation and the Transport Systems: Policy Issues and Implications

Panelists and Papers Presented

Richard H. Bradley, Deputy Commissioner, Bureau of Public Transportation, Connecticut Department of Transportation, Wethersfield, Connecticut

Odd Gulbrandsen, Research Leader, The Institute of Transport Economics, Oslo, Norway
"Transport System's Oil Dependency: A Long Term System Dynamics Policy Analysis"

Gordon J. Fielding, Professor of Social Science, Director, Institute of Transportation Studies, University of California, Irvine, California
"Questions Regarding Transit's Energy Effectiveness" (Paper prepared in cooperation with Gregory L. Thompson)

Gerard Monot, Chief, Transport Services, Agency for Energy Economics, Ministry of Industry, Paris, France
"Energy Saving in Transportation: The French Policy"

Donal O'Sullivan, Assistant Chief Engineering Adviser, Department of the Environment, Dublin, Ireland

"Energy Conservation in Transportation: Land Use Planning and Management" (Paper prepared in cooperation with A. Metcalf, Department of the Environment)

Daniel Roos, Director for Transportation Studies, Massachusetts Institute of Technology, Cambridge, Massachusetts

Policy Issues and Implications

The objectives of this workshop were:

- to suggest policy issues to be addressed and
- to identify the complex factors involved in the decisionmaking process.

Relating transportation performance to energy goals and to general socio-economic activity and progress is a complex endeavor, requiring focus on policy as well as technical issues. One participant set forth a list of ten policy issues--including effects of pricing policy, trends in fuel use, efficiency accounting procedures, governmental priority determinations, establishment of efficiency specifications for technological development--which he urged researchers to address urgently.

Discussion on this subtopic produced a wide-ranging variety of comments and questions. One participant dismissed the possibility of formulating a general trans-national transportation strategy on the grounds that policy decisions in each country must be related to its national energy product system. Several expressed a pessimistic view of future energy availability and stressed the need to conserve and stretch out fossil fuel supplies. A basic question was put in the form: "What is the national objective of energy conservation--to eliminate energy imports? To meet the requirements of national defense?" Another participant questioned whether energy should be a dominant consideration in transportation studies.

Resort to free market mechanisms and to user fees and taxes as tools for enforcing energy conservation by reflecting the true cost of road transport was endorsed by virtually all participants. At the same time, the likelihood of these tools being utilized in any significant way was by and large dismissed. It was conceded that effects of such measures on established social and economic patterns would impact adversely on substantial sectors of the community and thus would not be acceptable politically in Western democratic societies.

There was general agreement that no strong case could be made for mass transit except where conditions and locational situations specifically favor it. Given the massive investments necessary, the pressures on diminishing resources, and the current state of economic difficulty, it would be difficult for proposals for new public programs to meet the test of political and economic reality.

How to communicate with political decisionmakers, how to "teach truth to power", was a question of fundamental importance. The sense of the discussion was that the onus of communication lay with the analyst, that it was up to the analyst to translate and present his findings in such a way as to aid, not confuse, the decisionmaker in his efforts to improve the system's efficiency.

Finally, it was noted in the discussion that analysts and researchers must be mindful of their own predictive fallibility. Events have not always confirmed their predictions or analyses. Moreover, account must be taken of what one participant called the "realities of uncertainty"--exogenous developments, such as the impact of shocks and severe shortages, which can radically alter behavior and attitudes.

THE IMPACT OF THE TRANSPORTATION SYSTEM ON THE ENVIRONMENT

The three workshops conducted under this general agenda item emphasized the complexities involved in defining and discriminating among the many factors to be taken into account when evaluating environmental assessments for transportation decisionmaking. The state-of-the-art discussion examined the development and use of environmental review and measurement techniques and the attendant problems requiring resolution. The Performance Indicators Workshop reviewed the advantages and disadvantages of various measures and attempted to identify the types and quality of data important, if not crucial, to environmental assessment. The workshop on Policy Issues and Implications focused on the decisionmaking process--how adverse environmental impacts can be averted or controlled through improved assessment approaches.

The Impact of the Transportation System on the Environment: The State of the Art

Panelists and Papers Presented

Norman W. Arnold, President, M and H Services, Inc., Miami, Florida

Leon N. Larson, Director, Office of Environmental Policy, Federal Highway Administration, U.S. Department of Transportation, Washington, D.C.
"The U.S. Experience in Examining the Environmental Impacts of Highway Projects"

Richard Milbrodt, City Manager of South Lake Tahoe, South Lake Tahoe, California

C. Kenneth Orski, Vice President, The German Marshall Fund, Washington, D.C.

Joseph Passonneau, Passonneau and Partners, Washington, D.C.
"Environmental Impact Analysis is a Pricing Process"

State of the Art

Objectives of the workshop were to discuss:

- experiences in predicting and measuring the environmental impact of transportation improvements,
- development and application of mitigation techniques, and
- the difficulties associated with the development of a common definitional context for use and comparative analysis among impacts.

Papers presented during the state-of-the-art session served as background for the presentation by discussants from the United States, Norway, Sweden,

and the Netherlands. Additionally, these papers highlighted the linkage of environmental issues with those of safety, energy, and urban form.

During the course of the discussion, key points addressed concerned:

1. whether the potential damages created by highway construction and operation of surface transportation systems are being ameliorated,

2. whether those people who are adversely affected are being adequately compensated for these damages,

3. whether transportation investments are being made in such a way that both transportation and environment are improved, and

4. whether additional methods should be developed to entice people from private automobiles into public transportation modes.

In the initial presentation of the session, attention was focused on both the positive and negative environmental effects of surface transportation systems on the environment. As illustrated through a series of slides presented by one panelist, the increased sensitivity to the adverse environmental impacts of surface transportation systems (i.e., highways) was first manifested by the public reaction to the urban extensions and construction of certain segments of the Interstate Highway System. In his opinion, the expropriation of public parklands and historical sites, the disruption of neighborhoods and the minimum compensation provided for real estate expropriated generated widespread group activism and assured the salience of environmental impact concerns as a policy issue of the 1960s and 1970s. It was emphasized, however, that positive and aesthetic impacts of surface transportation systems have often been overshadowed by its adverse effects. Some of the positive impacts have been enhancement of the architectural quality of cities, enhancement of rural landscapes, and improved human mobility.

In tandem with the discussion of adverse long-term environmental impacts was a discussion of "just compensation" for expropriation of intangible "property." The central question of the discussion was: does adequate compensation exist for those whose property is not expropriated for highway projects, but who may suffer long-term effects during the life of the system? Commenting on the issue, one discussant related the problem of persons who reside along highway interchanges. Undoubtedly, the attrition on the environmental quality witnessed by these residents and other long-term, "fallout" adverse effects must be considered and evaluated. Whether this problem can be adequately addressed and resolved in the highway design and location processes looms as an issue for continued debate. It was noted that in Europe (specifically, Denmark and Norway) transportation decisionmakers, when determining "just compensation," limit their consideration to those who are "directly" affected--i.e., physically influenced or displaced by a project.

One author pointed out that some of transportation impacts are objectionable even though they do not involve the taking of goods (real

property) but do involve consequential damages (i.e., damages where there is no transfer of property but a taking of value, damage to a historic district, the serenity of a neighborhood). All of these "takings," it was noted, represent transportation costs. It was argued that where these costs cannot be paid for in full or eliminated, the transportation investment should not be made. When interstate freeways were constructed or planned in the United States through dense urban areas or in valued natural landscapes, the difference between actual costs and the total cost carried on project budgets was large. As a consequence, the public has reacted with an equally large resistence to the projects.

Clearly, opinions varied on these issues; however, the contributions of participants indicated agreement regarding the necessity for making transportation investments in a way that improves both the environment and the level of transportation services, promotes efficient use of energy sources, and preserves the fabric of the community.

As noted by one discussant on highway construction, the United States has encouraged low density residential development in suburban areas. This dispersal has caused significant segments of American society to rely on automobiles. As a countermeasure, some experiments have been aimed at increasing density in areas served by mass transit. In one such experiment, described by a panelist from South Lake Tahoe, California, an arbitrary housing development criterion was established, offering financial incentives based on a lot's proximity to transit services. This was eventually declared unconstitutional. Stoppage of new road construction (a policy of "non-construction") has also been used to discourage dispersal.

The concern with vehicular transportation systems' adverse impacts on city streets was expressed in an exchange which focused on American street design in urban areas as contrasted with street designs in various European countries. It was generally acknowledged that the Dutch have done much to improve the quality of streets. Through landscaping and the requirement for reduced speeds for vehicles, streets have been made more liveable and more aesthetically pleasing. It was noted, however, that in America, the transformation of central city streets from open places to transportation arteries represents environmental impact at its worst. Though systems of walkways and pedestrian malls have been designed and used in the United States to insulate pedestrians from the interference of vehicles and to improve the aesthetic quality of the streets, the European countries have made greater use of these approaches.

Considerable attention was also devoted to the issue of using transportation investments to promote energy conservation. Investments in projects designed to encourage the use of non-energy intensive systems, such as bicycle paths and lanes, were generally supported. One participant noted that American street designs, unlike many in Europe (e.g., Holland) do not enhance bicycle usage. Emanating from this observation was a discussion of whether and how the American public could be enticed from automobiles and encouraged to use other forms of transportation.

The second half of the workshop session focused on how the highway program has reviewed and evaluated environmental factors in developing highway projects. The process of considering environmental impacts has been institutionalized in the United States through the use of the Environmental Impact Statement (EIS). Consequently, the Federal government makes the final determination on the trade-offs between transportation improvement and environmental quality on federally funded projects. As noted in the discussion, the greatest number of EISs occur on highway projects.

As noted in the second paper presented in this session, the EIS Review Process has been designed to reveal the major differences between alternatives and to highlight mitigation measures needed to lessen the adverse impacts expected to result from the selected alternatives. While comparing the relative merits and costs of the environmental impact associated with identified alternatives may not be simple, evaluating projects against absolute standards has proved to be even more difficult for decisionmakers.

Notwithstanding the substantial research and experience accumulated in recent years, transportation policymakers, when making assessments, are often hampered by the lack of empirical verification and by insufficient knowledge of the social aspects of environmental impacts which are often detrimental. While it was noted that social impact models and indices have assisted in identifying the potential impact of projects, it was suggested that more research be devoted to the use and development of non-economic models designed to measure the value that individuals place upon environmental amenities.

In general, the sense of the workshop was that the transportation planner will always be confronted with the dilemma of deciding what to emphasize and what to omit in working up a comprehensive impact analysis. In many cases, the question will be resolved by determining what is quantifiable and what can be gleaned from greater public input. It was emphasized that intangible impacts such as community cohesion and psychological well-being must always be assessed in terms of the perceptions of a project.

Assessment techniques of physical and measurable impacts have proved successful in many instances (e.g., noise assessment methods are considered fairly accurate.) Successful techniques also exist for measuring baseline conditions although impact assessments in these areas tend to be influenced by subjective judgments of the analyst. The number and types of wetlands or historical structures affected by a project may be easily defined, but the accuracy of the assessment is attenuated when attempting to determine the normative significance of the quantitative analyses. The following was raised by a discussant to illustrate yet another limitation of quantitative analysis.

In his opinion, the air quality problem may continue to be perplexing and challenging for transportation decisionmakers. Auto emissions of carbon monoxide, hydrocarbons, and nitrogen oxides unquestionably pose health risks--but to what extent are these risks quantifiable? Moreover, current pollution standards are based on the provision of an adequate margin of safety. The relationship between the risk of actual damage and the standard which sets the safety margin is unknown. Equally unknown is the degree of protection offered by the standard. Is it dangerously narrow, or unnecessarily

wide? This creates difficulties in trying to quantify the benefits of meeting the standards and making tradeoffs with other standards.

A need was also expressed for upgrading the state of the art in forecasting secondary impacts. These impacts include changes in local economic growth and development patterns, land use control activities due to transportation improvement, and energy analysis.

The Impact of the Transportation System on the Environment: Performance Indicators and Data Requirement

Panelists and Papers Presented

Karen B. Alschuler, Urban Planner and Associate, Skidmore, Owings and Merrill, Boston, Massachusetts
"Social Impact Assessment Put to Practical Use for Better Transportation and Better Urban Development"

Salvatore J. Bellomo, President, BKI Associates, McLean, Virginia

George A. Bonina, Environmental Specialist, Office of Transportation and Land Use Policy, U.S. Environmental Protection Agency, Washington, D.C.

Armando Lago, President, Ecosometrics, Inc., Bethesda, Maryland

Ernst-Albrecht Marburger, Federal Office for Road Transport, Cologne, Federal Republic of Germany
"A Direct Approach for the Evaluation of Air Pollution Generated by Motor Vehicles in the Federal Republic of Germany"

Fred H. Sanborn, Manager, Social and Economic Studies, Michigan Department of Transportation, Lansing, Michigan

Performance Indicators and Data Requirements

Objectives of this workshop were:

- to discuss the advantages and disadvantages of various measurement techniques and
- to suggest the types and quality of data required for making assessments.

This session began with a brief review of the types of environmental impacts which may occur at various stages of the transportation development process as illustrated by a series of slides presented by the moderator. An important aspect of environmental impacts is their often dynamic nature. These environmental effects do not occur simultaneously but tend to change as time passes. The planning or anticipation of a transportation project leads

to construction which culminates in a start-up phase of operation. This phase may last for several years, with gradual changes, until a stable operational condition is achieved. Some impacts, such as demographic or land-use changes, may not be visible for many years after operations have stabilized. It was noted that each stage of the process has its own environmental impacts which can differ dramatically in consequence. Categories of impacts which have been developed by the U.S. Department of Transportation, Housing and Urban Development and other Federal agencies were presented as checklists for principal components of the physical and social environment. On the physical side, these components include geology, soils, special land features, climate, and air. The social side includes components such as services, safety, physiological well-being, psychological well-being, visual quality, and historical and cultural resources.

One method of categorizing impacts for study is by aspects or dimensions of the environment affected by some emission. Relevant dimensions can include, among other definitions, visual quality, physiological well-being and atmosphere. Transit system emissions and the movement of vehicles can act on these dimensions to produce impacts.

While social impact models and indices have assisted in identifying the potential socioeconomic impacts of transportation projects, the quality of data has been questioned. One discussant illuminated the successes as well as problems of social impact assessments, and emphasized that once a basic data profile is established, analysts must direct their resources toward strengthening and facilitating communication between community representatives and decisionmakers. The inevitability and desirability of expanded citizen participation emerged as a recurrent subject for discussion by workshop participants. Subsequent discussion on this topic focused on ways to encourage and promote an interactive process among agencies, analysts, and citizens.

Methods suggested for enhancing the process included open meetings, dissemination of newsletters, mailings, and informal interviews. It was suggested that analysts performing assessments should be prepared to attend meetings, listen to opinions, and address the concerns of groups potentially affected by a project. Expanded public involvement programs, it was noted, can contribute to a greater understanding of the social fabric of the community and enhance the credibility of persons performing assessments. Consistent with the recommendation for an expanded citizen participation framework was the recommendation that citizens be provided with more initial information regarding how decisions to expand or develop transport often are initially formulated by policymakers.

A systematic, interdisciplinary approach in making assessments was viewed by participants as a requisite for achieving a balanced consideration of environmental impacts and in evaluating their significance.

Exchanges on transportation's impacts on the physical environment in general, and the air quality standard in specific, further highlighted the

following issues during this session:

- Should there be environmental standards such as--should transportation decisionmakers set environmental objectives?
- What should the role of cost-benefit analysis be in the process?
- What procedures should be used in trading-off issues that are quantifiable with intangible elements that defy quantification?

Stimulated by a paper written on the evaluation of air pollution vehicles in the Federal Republic of Germany, discussion concentrated on economic losses due to exposure to pollutants.

This paper speculated that: "if a casual relationship exists between global air pollution and respiratory diseases, the same relationship holds true for local concentrations of polluting agents as well." This assumption makes it possible to apply the cost per ton of emissions, estimated on the basis of the global hypothesis to the air pollution generated by motor vehicles. This theory is of particular interest to many transportation planners because it deals with the direct health related cost of a project instead of merely how well a project meets air quality standards. The controversial nature of some of the author's theories was noted by panelists. One panelist commented that though the paper is of significant interest, (1) the scientific community does not accept the existence of threshold values for all pollutants (this issue has been debated widely in the United States), and (2) the relationship between global conditions and local conditions is questionable. He added that local conditions, local populations, and other elements potentially affecting health may have a greater impact than air pollution.

Though the United States does not accept the fact that threshold values exist for air pollutants, one participant related an experiment which is occuring in one American community. A quantified threshold level has been established and defined in this community as the level which must be maintained to allow survival in that particularly sensitive environment.

Establishing a positive correlation between exposure to defined levels of air pollutants and resulting adverse health effects is limited by the lack of empirical verification and data. Therefore, a need was expressed for developing valuation methods to assess the health effects of air pollutants.

Discussants noted that automotive emissions are a major contributing factor to air pollution. Though modification in automobile technology has reduced substantially the emissions from individual vehicles, aggregate emissions from all vehicles still present a serious problem. Perhaps the most promising areas for solution to these problems offered were related to individual response to the energy crisis. For example, reductions in auto size and energy consumption and shifts from single-occupancy driving to carpools and from automobiles to mass transit will reduce automotive pollution emissions.

Recognizing current and future economic constraints, it was felt generally that the development and planning of large traffic infrastructure

will be limited during this decade. Hence, smaller projects will be emphasized. A changing demand will be placed on the process of impact assessment. It was suggested that decisionmakers re-evaluate and revise the environmental impact approach to single projects, since there will be fewer federally sponsored projects. This may mean restructuring research toward performing environmental analysis of regional plans and programs. The lack of large amounts of money for impact analysis will require the use of quick and easy analysis methods.

A final need was expressed for more coordination in integrating the processes for environmental review with the process for design and construction management. People performing the analysis are removed from design and engineering personnel. Thus, environmental studies are not incorporated into the design process. The sequential nature of the process also makes it time-consuming and costly. Efforts made to involve designers and engineers in the assessment process can provide positive payoffs in the development of detailed design and construction specifications that are sensitive to environmental findings.

The Impact of the Transportation System on the Environment: Policy Issues and Implications

Panelists and Papers Presented

Robin Bidwell, Research Director, Environmental Resources Limited, London, England
"Environmental Impact Assessment in Europe: A Review of the Principal Characteristics and an Examination of Its Effectiveness"

Martin Convisser, Director, Office of Environment and Safety, U.S. Department of Transportation, Washington, D.C.
"Environmental Considerations in the U.S. Department of Transportation Decisionmaking Process" (Paper prepared in cooperation with Camille H. Cleveland, Environmental Program Analyst, Office of Environment and Safety)

Jose A. Gomez-Ibanez, Senior Staff Economist, Council of Economic Advisers, Washington, D.C.

John Kain, Chairman, City and Regional Planning Program, Harvard University, Cambridge, Massachusetts

Marvin L. Manheim, Professor and Head, Transportation Systems Division, Massachusetts Institute of Technology, Cambridge, Massachusetts
"Implications of Uncertainty for Environmental Policy"

Jip van Klaveren, Environmental Specialist, Directorate-General of Transport, Ministry of Transport and Public Works, The Hague, Netherlands
"Conflicts Between Transportation and Environmental Interests" (Paper prepared in cooperation with R.A. Braackenburg van Backum, B.P. Rigter, and E.W.H. Mackinlay)

Policy Issues and Implications

Objectives of the workshop were:

- to discuss how adverse impacts can be ameliorated or controlled through policy development and planning processes and
- to identify the methods needed to support decisionmaking in environmental assessments.

Papers presented during this session covered a broad range of environmental policy issues--some of which served as key points for examination and review by workshop participants. One presentation stimulated an initial exchange on the merits of the Environmental Review Process in the United States. It was generally agreed that the Environmental Impact Statement (EIS) has improved the quality of public sector decisionmaking for transportation projects.

One participant noted that the requirement for an EIS has forced consideration of potential environmental impacts at all levels of government and has resulted in the elimination or modification of many proposals that would have produced serious adverse impacts. As examples, he discussed several urban highway proposals which were submitted in 1978 and 1979 for action by the U.S. Department of Transportation through reviews of draft and proposed final EISs. A number of common problems were revealed in all the proposals. These problems included extensive displacement of people (among them a disproportionate number of minority residents) in communities where little relocation housing was available; and use of bypass highways that might stimulate growth in suburban areas, which in turn would increase energy consumption. It was noted that these issues might otherwise have been buried were it not for the EIS process.

The marked contrast between the European approach to environmental review and the American approach was underscored by a review of the principal characteristics of environmental impact assessment process in Europe. During the discussion it was noted that in the United States the principle that decisionmaking should be based on knowledge of real alternatives, as well as the needs and concerns of persons potentially affected, is fundamental to the environmental review process. The EIS process sets forth alternatives, impacts of various alternatives, and possible mitigating steps. The "environment" in the United States is defined broadly to include physical, social, community, and cultural impacts, as well as other elements.

European environmental assessment processes, on the other hand, emphasize a more restrictive, technical approach. The process is used to answer specific questions rather than highlight the issues which need to be traded-off and resolved. Assessments are performed only to assist the decisionmaker and are heavily quantitative. Furthermore, opportunities are limited for citizen participation in the planning and decisionmaking process. It was pointed out that prior to the emergence of environmental impact of transportation systems as a policy issue in the United States, many European countries had developed specific procedures for examining the impacts of new developments. Thus, the

tendency was to continue to join aspects of the transportation development process into a single decisionmaking tract. This contrasts with the United States where systems planning is separate from the environmental review process.

The question raised by this review was whether the technical, non-participatory approach used in most European countries can be more helpful to the decisionmaker than a broader approach which ensures a framework for citizen participation. Although some proponents recognized the merits of the broader approach, they also recognized its limitations. It was questioned whether the elaborate EIS procedure, as conducted in the United States, is cost effective in terms of producing data needed by administrators to make truly informed decisions.

Recognizing the advantages and disadvantages inherent in varying assessment modes, it was noted that policy decisions in transportation will invariably involve conflicts between the mobility needs of people, on one hand, and socioeconomic and ecological interests on the other. The transportation decisionmaker will seek compromises that are least detrimental to the functioning of the system, yet support a harmonious ecological balance. It was noted also by some discussants that most environmental problems can be resolved if enough money is available. The questions then remains: what is an appropriate balance between transportation needs and environmental requirements, how much is it worth, and how much are people willing to pay? Inasmuch as the relative significance of impacts is dependent on values, decisions many times will depend heavily on the policymaker and evaluator's view of the relative importance of different costs and benefits and his/her concept of "just" or fair distribution of impacts in society.

Comments made by one panelist prompted a shift from assessment approaches to the environmental effects of auto emissions and toxic substances. Panelists noted that the aesthetic problems of highways have been ameliorated to a large extent. However, auto emission and the current air quality standards pose unresolved problems. The discussion futher questioned whether the air quality standards have been pushed too far.

With the passage of the Clean Air Act of 1970, the Federal government set ambient air standards and established a control program administered by EPA. Administrators, however, were given much latitude in setting the standards. From this discussion, it was noted that specific auto and truck emissions targets and standards were set (with no analysis) before the costs to attain the standards or the specific health effects resulting from the pollutants were known. Though it was emphasized that it is difficult to place a dollar value on the benefits obtained from the automotive emissions control program, it was suggested that there may be some areas where the costs may have exceeded the benefits. It is recognized that an adverse effect from toxic substances may lead to illness, but the level at which illness occurs is unknown.

Fine tuning of the standards was suggested as a way of addressing this problem. It was noted that the cost of controlling and cleaning up pollutants rises steeply as a 100% control or zero emissions is approached. The United

States has been approaching that level with some pollutants. One example is the revision of the automotive carbon monoxide emission standard from 7 to 3.4 grams per mile. This decrease represents a modest change from a 93% clean-up to a 96% clean-up, but the cost of that change has been estimated between $500 million to $1 billion per year. Some discussants suggested that the health effects of this change were negligible.

A consequence of increasing attention to environmental issues is the tremendous uncertainty about what will be implemented and what will be the effects of a project. Groundwork for a discussion on this subject was laid by a presentation which explored "uncertainty" as a dominant theme in environmental policymaking. It was pointed out that transportation agencies in both the public and private sector will have to evolve significantly if they are to survive in an era marked by uncertainty. Conceptual schemes used to diagnose an agency's ability to deal with uncertainty were presented. The discussion which followed centered on the activities in which transportation agencies are involved--planning, design, and implementation.

Traditionally, highway transit agencies, as well as other public works agencies, have had a well-organized sequence of activities which they follow for planning design and implementation. Likewise, most State highway departments have had an orderly process. Some discussants argued that in the United States, as a result of the Environmental Impact Statement, this orderly process no longer works. Many transportation administrators are realizing that their organizations can no longer be managed under the assumption that the work flow will be sequential. Most transportation agencies have very compact, compartmentalized departments. When a project moves from stage to stage, it is approved and does not return. Everything within the agency reinforces this sequential pattern. The introduction of citizen participation and environmental assessment, which are non-sequential recurring events, causes significant and disruptive procedural changes. People within organizations resist this change. Consequently, transportation planning and management agencies in both the public and private sector must avoid rigid organizational structures which stifle their ability to adapt to change. The organizational structure of transportation agencies must recognize uncertainty as a dominant force in determining future policy, i.e., uncertainty about the attitudes of interest groups, impact of certain projects, and funding.

It was generally agreed that a need exists among transportation planners to continue to expand the process so that important issues emerge for open debate, to simplify procedures, and to expedite the decisionmaking process. Improved interagency coordination is needed. A need also was expressed for transportation investments to be made in a way that improves both transportation and the environment. Thus, investments should continue to be subjected to cost benefit analyses. Moreover, methods are needed to ensure that these costs are calculated accurately. A recurring theme of the discussion was the question: "who really gains or loses in transportation system development?"

It was noted that group activism and continuing sensitivity to environmental quality will prompt transportation decisionmakers in Europe and the UnitedStates to develop methods of expanding public participation in the decisionmaking process.

THE TRANSPORTATION SYSTEM AND URBAN FORM

Transportation sytems and urban form interact significantly and dynamically; but, the relationship is complex and intricate, affected by largely unpredictable views and attitudes on trade-off possibilities. How the relationship is currently being evaluated and measured was the subject of the State-of-the-Art Workshop. The workshop on Performance Indicators and Data Requirements centered around ways to develop further information and insights into the relationship, including the issue of central city revitalization. The Policy Issues and Implications Workshop focused on the complications involved in initiating and planning policy actions.

The Transportation System and Urban Form: The State of the Art

Panelists and Papers Presented

Philip H. Bly, Transport and Road Research Laboratory, Department of Transport, Crowthorne, England
"The Influence of Transport of Urban Performance"

Irving Hand, Director, Institute of State and Regional Affairs, Pennsylvania State University, Middletown, Pennsylvania

Herman Knoflacher, Professor, Institute of Traffic Safety, Vienna, Austria
"Human Energy Expenditure in Different Modes: Implications for Town Planning"

Sumner Myers, Director of Technology and Transportation, Institute for Public Administration, Washington, D.C.

Frans Timmerman, Projectbureau Integral Transport Studies, Ministry of Transport and Public Works, The Hague, Netherlands
"The Relationships between Land Use, Residence and Workplace Mobility and Commuting: An Integrated Approach" (Paper prepared in cooperation with A.C.P. Verster, Netherlands Economic Institute, Rotterdam, Netherlands)

State of the Art

Objectives of this workshop were:

- to delineate current methods of measuring and modeling effects of transportation systems/urban form initiatives;
- to review existing transport/urban form interaction models and research studies; and
- to consider the application of both models and empirical techniques, emphasizing comparisons between analytically derived estimates and real-world conditions.

Presentations during this session served as the basis for discussions on the changing relationship patterns between transportation and urban form and on the advantages and disadvantages of urban form interaction models.

In the post World War II period, the close transportation/urban form relationship in Western societies has been demonstrated in a variety of ways. It was noted that transportation initiatives and investment are associated, for example, with a number of significant urban or urban-related trends. In the U.S., the growth and diversification of Western cities, the gentrification of delapidated central city areas (and the problems created by the exodus of the former, generally poor, inhabitants to the periphery), and the increasing numbers of urban dwellers moving to suburban and small city environments, are all linked to transportation availability and development. Transportation investment and finance has also played an important part in central city development in San Francisco and Baltimore and in waterfront and tangential commercial projects in Boston. Similar relationships and developments are discernible in Canada and Western Europe.

It was acknowledged that present-day approaches to transportation/urban form planning processes and thinking are influenced by the economic difficulties experienced since the early 1970s. This thinking is characterized by a growing preoccupation with conserving scarce energy and land and open-space resources, and with efficient use of scarce capital and natural resources. There is greater stress on better management of existing resources, greater emphasis on maintenance, improvement, and rejuvenation of urban transportation systems than on new investment.

Current tendencies in land use and development, as suggested in the discussion, are at least partially tied to apprehensions about future transportation policies in a period of economic exigency. The present boom in office space construction in central city areas, as opposed to other locations, was offered as one example of this thinking.

The emphasis on improvement and revitalization of existing transport systems and urban capital highlights the need for reliable research and comprehensive transportation/urban form models to guide and assess policies, planning, and investments. Existing research provides some guidance and knowledge about the mechanisms useful for assessing the results of transportation/urban form initiatives and interactions. Among the relationships that have been established and confirmed are good transport and economic development (positive, but limited in impact), trip length and city size (positive), auto ownership and urban density (negative), and the effects of urban form differences on overall vehicle miles of travel and travel behavior (insignificant).

One widely acknowledged difficulty in applying existing findings and techniques is that results are restricted to specific sample areas and are therefore not generalizable beyond the socioeconomic conditions peculiar to those areas. Similarly, while much is known about the large-scale aggregate effects of transportation initiatives on urban form, they are not easily applicable to specific locations, programs, and objectives. The effects of these initiatives are for the most part realized at the small-scale level.

The Transportation System and Urban Form: Performance Indicators and Data Requirements

Panelists and Papers Presented

Eric Beshers, Deputy Director, Office of Economics and Public Investment, U.S. Department of Transportation, Washington, D.C.
"The Impacts of Urban Transportation Policy Actions on Urban Revitalization: Some Preliminary Findings from the NATO/CCMS Study" (Paper prepared in cooperation with Helen Doo, Policy Analyst, Office of Economics and Public Investment)

Ralph Gakenheimer, Professor, Urban Studies, Planning and Engineering, Massachusetts Institute of Technology, Cambridge, Massachusetts

Michael Goldberg, Associate Dean, Commerce and Business Administration, University of British Columbia, Vancouver, British Columbia, Canada
"Transportation Systems and Urban Form: Performance Measures and Data Requirements"

Christopher G. Turner, Principal, Economic and Transportation Planning Group, London, England
"Development Expectations and Experiences of Major Public Transportation Investments" (Paper prepared in cooperation with Peter L. Watson, The World Bank, Washington, D.C.)

Antonio Valdez, Ministry of Transport and Communications, Madrid, Spain

Michael Wegener, Research Fellow, Institute of Urban and Regional Planning, University of Dortmund, Dortmund, Federal Republic of Germany

Performance Indicators and Data Requirements

Objectives of this workshop were:

- to identify research areas and data requirements for further exploration of the transport/urban form relationship and
- to suggest techniques and approaches for obtaining this data.

The shortcomings and limitations of existing research models and techniques, as identified in the discussion, indicated a number of perceived data requirements: more conclusive hard data about the magnitude and scope of the transport/urban form relationship; more effective analysis of the transport/-land development relationship; more research into the impact of exogenous variables on the long-range cause and effect relationship of transportation and urban form.

Considerable discussion centered on the importance of human behavior and responses to transportation and urban form initiatives. The success of these initiatives depends largely on the timing of public response to transport changes and people's spatial preferences, which are not represented in existing

models. The lack of such essential information means that models cannot provide firm planning guidance. One suggested solution to this problem was more accurate assessment of "subjective transformation"--the tendency of human beings to transform objectively measurable quantities, such as time and distance, into certain specific responses. Another proposal focused on ways of determining what people want and prefer. It was noted that preference rankings are not necessarily an accurate indicator of actual behavior, that preference is a multi-objective function related to the kind of human energy budget people are prepared to expend to achieve a certain lifestyle.

Allied to the human behavior question was the question of "irreversible shifts." Given the resources required for major transportation programs, the time frame required to evaluate impacts, and the unpredictability of public response, should experimental initiatives be restricted to reversible (i.e., relatively low-cost, non-rail) strategies? Affirmative opinions were countered by comments that reversible options could not be relied on to meet serious continuous problems.

The premise that the best plans can go seriously astray because of the unpredictability of outcomes was the basis for a proposed set of critical indicators for assessing urban transportation investments. This proposal called for:

- the development of better measures of "before and after" and "with and without" accessibility, so that the relative impact of a change in the supply of services can be calculated;

- a specification of time series changes in key urban characteristics (e.g., transit patronage, employment densities) to assess the consistency of existing urban structure and proposed transport supply changes;

- the development of measures of urban economic development which would facilitate the synchronization of changes in public transportation supply with events in the urban economy;

- critical review of financial, institutional, and policy bases necessary for promoting and achieving public transportation-related development at selected locations, and the assessment of probable community attitudes to such development.

This proposal, which received general approval, was accompanied by the injunction that a program should not be undertaken when a specific land use/urban development outcome is essential. An unrelated cautionary note was struck in another suggestion that emphasized the need for a "cancel supply" option--ways to reduce transport service without inordinate danger to land development--to be built into system planning.

On the matter of transportation programs aimed at revitalization of urban areas, suggestions were made that more consideration and more careful scrutiny be given to the impact of revitalization of a particular area on spatial

distribution and shifts of economic activities, and to the relationship of the program's objectives to larger economic, social, and environmental goals.

A more technical approach to meeting indicator and data needs consisted of a proposal for analysis of microspatial details at the local level (for example, zoning, land value, routing, station location, and modal interchanges), with focus on the disaggregation (rather than aggregate analyses) of existing data to smaller units so that impact consequences are explicit and distinguishable from other intervening variables.

The Transportation System and Urban Form: Policy Issues and Implications

Panelists and Papers Presented

Pieter DeMan, Secretary General, Ministry of Transport and Public Works, The Hague, Netherlands

David Kahn, General Physical Scientist, Transportation Systems Center, Research and Special Programs Administration, U.S. Department of Transportation, Cambridge, Massachusetts
"Dynamic Modeling of Urban-Regional Transportation Systems"

Ronald Kirby, Director, Transportation Studies, The Urban Institute, Washington, D.C.
"Travel and Urban Form: Empirical Relationships and Policy Implications"

Roger L. Mackett, Senior Research Fellow, The University of Leeds, Institute for Transport Studies, United Kingdom
"Towards a Better Understanding of the Locational Choice Processes in Integrated Land Use--Transportation Models"

Stephen H. Putnam, Associate Professor, City and Regional Planning, University of Pennsylvania, Philadelphia, Pennsylvania

Richard Soberman, Professor, Joint Program in Transportation, Department of Civil Engineering, University of Toronto, Toronto, Canada

Ole Thorson, Chief Engineer, Department of Traffic and Transport Planning Division, Municipality of Barcelona, Spain
"Evaluation of Three Different Public Transport Schemes and Their Comparison with the Present System in the City of Barcelona" (Paper prepared in cooperation with Alfredo Morales, Chief Engineer, Department of Traffic and Transport)

Policy Issues and Implications

Objectives of this workshop were:

- to discuss the implications of the current socioeconomic milieu and

current data requirements for transport policy initiatives and planning,

- to review the relationship between urban form policy and household travel behavior, and

- to discuss the implications of certain performance and descriptive indicators for government policy initiatives.

It was generally agreed that given the state of current measurement techniques and recent data requirements, the relative impact of transport initiatives on development has significant implications for transport policy and planning. The current environment is characterized by a continuing loss of central city population, eroding modal shares to mass transit, and the growth of a necessarily auto-oriented medium in small cities. Moreover, it is not clear that private vehicle travel costs are going to be significantly increased over the long run. These factors together suggest continued dominance of the private car. Reducing vehicular travel and getting people to substitute mass transit for private car use will be increasingly difficult.

For planners and policymakers the fundamental questions remain: Can desirable spatial structure be achieved? What environments can be created? These are important issues, because the whole process of guiding development and revitalization and stemming economic decline is a crucial task for transport planners and policymakers in the 1980s. Suggested approaches to this task included the following:

- Transport policy initiatives should foster real estate investment in order to facilitate development, rather than relying on transport to act as the stimulus.

- Planners should encourage the multi-unit apartment building industry to respond to construction opportunity, exert public development controls, and bring them to bear in the local area of anticipated impacts.

- Planners must know when the local economy is rising and must coordinate transport initiatives with it so that the market has a chance to respond.

- Analysis of impact on a local scale, rather than a national scale, provides greater insight into the consequences of transport/urban form changes.

Are the demonstrated effects of transportation programs worth the necessary investments? The feeling generally was "yes." The consequences of transport initiatives may be limited, but in specified circumstances can be desirable and useful. The difficulty lies in the unpredictability of outcomes, desirable or not, and the impossibility of generalizing on the basis of site-specific results.

Transport/urban form initiatives were also affected by the conflict in values and goals between different elements in the decisionmaking process. The conflict is characterized by an interplay between quantitative issues and

distributive issues. Quantitative issues revolve around the absolute size of cities and the changes effected by shifting population patterns, the urbanization process, and immigration or natural increase. Distributive issues arise where size and population are spread over space and time and influenced by the dynamics of cooperation among members of a set in a particular sector or by competition between members of different sectors in an urban economy.

The complexities of distributive issues are the primary source of constraint and confusion in transport/urban form research. Quantitative issues of size are affected by distributional issues in ways that are particularly challenging to national policy decisions, because of national government involvement with issues of dynamic stability or instability of capital (for example, operating subsidies, demographic trends, natural resources, and human behavioral variances). Human behavioral variances also challenge researchers to produce rational, comprehensive and scientifically based explanations of transport/urban form changes on travel behavior.

Both quantitative and distributive issues have numerous implications for programmatic conclusions regarding the positive relationships between transport and land development. These program initiatives deserve government commitment and require government leadership.

Despite the variety of suggested approaches and emphases, the session ended with a general consensus on a wide range of basic premises: transport systems are important to central city development, to urban revitalization, to the guidance of growing cities, and to understanding the means of reducing service without inordinate damage to land development. Planners need to know the optimum circumstances or conditions conducive to attaining certain policy objectives. Transportation, as a facilitator rather than a stimulator of development, acts in combination with other factors, external events, and collateral activities. Appropriate spatial structure can be achieved, but more effectively on a narrow scale with regard to specific projects. Although planners and researchers have considerable data about large-scale transport/urban form relationships, they know more about impact consequences in small-scale situations. Because generalizations become increasingly difficult, transport/urban form initiatives and investments may require more local input in terms of assessments and objectives. National government leadership is essential in reconciling value conflicts between the decision and planning elements in transportation systems and urban form infrastructure.

THE ROLE OF TRANSPORTATION IN ECONOMIC DEVELOPMENT

Transportation's role in economic development was a subject difficult to keep within the prescribed bounds of the three workshop sessions. Each of the meetings was characterized by extended debate and discussion of the whole range of issues. This was perhaps inevitable, considering the complex nature of the transportation/economic development relationship and the difficulty of identifying the many linkages involved. In the course of the meetings, differences of opinion and interpretation were expressed on a whole series of basic questions: what is meant by economic development, the relative value of transportation in modern economies, measurements of efficiency, problems of investment and disinvestment, objectives of transportation policy, the role of government, and the realities of policymaking. Although no clear-cut consensus emerged on any of these topics, the meetings appear to have produced a highly useful exchange of views among the participants and a better understanding by all of what is known and what needs to be known on the general subject.

The Role of Transportation in Economic Development: The State of the Art

Panelists and Papers Presented

Thomas Domencich, Consultant, SUMET Associates, Montpelier, Vermont

Wilfred Owen, Senior Fellow, Foreign Policy Studies, Brookings Institute, Washington, D.C.

Robert Piper, Senior Policy Adviser, Transportation Services Branch, Alberta Economic Development, Edmonton, Alberta, Canada
"Transportation and Economic Development: The Growing Significance of the Transport Subsidy Issue" (Paper prepared in cooperation with Brian E. Sullivan, Assistant Deputy Minister, Transportation Services and Strategic Planning, Alberta Economic Development)

Judith W. Richards, Research Director, National Council for Urban Economic Development, Washington, D.C.
"Transportation and Urban Economic Development" (Paper prepared in cooperation with Michele B. Krasner, Project Manager, National Council for Urban Economic Development)

Wilbur A. Steger, President, CONSAD Research Corporation, Pittsourgh, Pennsylvania
"State-of-the-Art Assessment of Models Relating Transportation System Options to Economic Development Consequences"

Martin M. Stein, Director, ABT Associates, Inc., Cambridge, Massachusetts

State of the Art

The objectives of this workshop were:

- to define the connection between transportation and economic development and
- to review and evaluate current approaches and techniques for measuring transportation performance as it relates to economic development.

The need to define economic development in terms of the agenda topic arose at the outset and various definitions were proposed throughout the three days of discussion. There was no disagreement about its traditional meaning, as applied today to developing countries--improvement of basic growth indicators, such as GNP, national income, international trade, and competitiveness. In urbanized, mature, industrial societies, improvement of growth indicators is still important, but economic development is increasingly being interpreted in terms of other goals, broadly categorizable as "quality of life." These include welfare and equity objectives, aid to the poor and handicapped, distribution of income, employment opportunities, access to transportation and other services, population patterns, central city revitalization, and health, safety, and anti-pollution standards.

A variant of the traditional versus modern interpretation (Alberta, Canada was presented as an example) occurs in instances featuring a booming modern economy, based largely on a depletable resource and a sparse population, half of which is centered in two cities. Here the challenge is to use the opportunity provided by present economic growth to establish a sound basis for continued growth and improved quality of life after the key resource is gone.

The discussion revealed a variety of views regarding whether modern and traditional economic development goals conflicted with each other and to what degree. One view expressed was that in modern societies there was no conflict--that equity promotes growth. Other participants argued for greater emphasis on one or the other.

Whatever the stage of economic development, all participants agreed that an effectively functioning transportation system is essential. In a developing country it is a stimulus to growth--the "leading edge" of development. The transportation system is the vital ingredient for opening up the country and for making productive use of untapped natural and physical resources.

In developed countries, transportation systems are indispensable to the conduct of social and economic life. But opinions differed as to transportation's relative impact on traditional development goals. Most appeared to concur in the thesis that transportation no longer serves as the "leading edge," that it is an in-place, ubiquitous asset, generally accessible, but not determining in terms of classic locational theory. Except for certain industries and regions, its developmental importance has diminished. On a national level, minimization of transportation costs is a decreasingly significant factor in cost calculations. The opposing view, that continuing innovation and

improvements in transportation efficiency were essential for future economic health, at least in the context of productivity and international competitiveness, was strongly advocated by a number of participants. Some argued that technological innovation may yet restore to transportation its former "leading edge" role.

There was general agreement that industrialized societies (on which attention was almost exclusively centered) today confront a number of crucial problems affecting the transportation/development relationship--heavy dependence on and rising costs of foreign imports to fuel largely oil-based transport systems, the prospect of intermittent short-term oil shortages and long-term exhaustion of oil supplies, the massive demands on capital resources to maintain and rationalize existing transportation networks (not to mention investment in new systems), and the growing pressures on transportation to achieve quality of life goals.

Proper transportation policies and investment choices are needed to contend with these problems, and these policies and choices are dependent on sound evaluations and analyses of transportation performance and its socioeconomic impacts. Evaluations geared solely to economic impact are conceptually measurable, and a number of approaches, models and methodologies were noted and reviewed. Among these were micro and macro studies, general and partial equilibrium models, and linear programming and gravity models. Good results have been achieved in micro-oriented and regional studies. By and large, however, it was acknowledged that the predictive capabilities of the present state of the art are insufficient to meet the needs of the policymaker. The overall pattern of interrelationships between transportation performance, productivity, and economic and social objectives is unclear, and the data and insights fundamental to sound policymaking in transportation are lacking.

To a large extent, these gaps in available knowledge are attributable to the many complex economic variables at work in a highly-developed society. As some participants noted, however, the gaps are even more striking in the treatment of how transportation performance impacts on social and quality of life issues; for example, it was contended that transportation studies generally pay little attention to the "who gains what, who loses what" equation and to the general question of distribution of benefits and costs.

A strong point made by urban development planners and analysts among the participants was the absence of an adequate body of literature on the interaction of transportation and central city revitalization. It was noted that available studies are mainly regional or modal oriented and rarely integrate transportation with central city development needs. Such integration, it was argued, is essential to effect structural changes in central city economic activity compatible with changing trends in industrial and residential location patterns and thereby stimulate private investment and job creation.

Comments on existing transportation/development measurement techniques clearly showed that single-formula approaches were perceived to be of little value. Advocated instead was a mix of approaches, solutions, and options that

would facilitate both long-term and short-term planning. Public, private, and joint transportation investment strategies should be more intensively explored, and innovative institutional arrangements--management and investment-oriented--have to be devised. Performance efficiency should be the objective, but cannot be the sole criterion. The effects on a whole range of equity, environmental and other quality of life considerations must be factored into any proposed course of action.

For researchers and analysts, this was generally accepted as constituting a need for hard, objective, and more detailed and precise data, and for more comprehensive efficiency and effectiveness criteria. Micro studies at the regional and local levels which examine linkages between transportation investments (or disinvestments) and development may be best suited to this approach. They suffer from the disadvantage, however, of having limited applicability on the national level and, thus, may not be readily adaptable to broader policymaking requirements.

The Role of Transportation in Economic Development: Performance Indicators and Data Requirements

Panelists and Papers Presented

W. Bruce Allen, Associate Professor, Regional Science and Transportation Department, University of Pennsylvania, Philadelphia, Pennsylvania

Ulrich Ernst, Senior Research Associate, The Urban Institute, Washington, D.C.
"Performance Criteria for Tranportation Policies: A Spatial Perspective"

Paul O. Roberts, Professor of Transportation, Massachusetts Institute of Technology, Cambridge, Massachusetts

Gabriel Roth, Economic Development Institute, The World Bank, Washington, D.C.
"Financial Profitability as an Investment Criterion for Transport Projects"

William B. Tye, Principal, Putnam, Hayes and Bartlett, Inc., Cambridge, Massachusetts
"Performance Concepts for Measuring the Role of Transportation in Economic Development"

Arthur L. Webster, II, President, EXP Associates, Inc., Bethesda, Maryland

Performance Indicators and Data Requirements

The objectives of this workshop were:

- to identify and examine performance criteria and

- to suggest research needs and requirements in addressing those problems.

Discussion in this workshop was wide-ranging, but a number of subjects received special attention. One concerned the seriousness of the economic difficulties now confronting the Western industrialized world.

One view strongly expressed was that despite the signs of crisis--declining economic activity and productivity, high inflation, rising unemployment, and limited investment--the health of the economy, at least in the United States, was basically good. Problems admittedly exist in certain sectors of the economy--urban (especially central city) decay, regional disinvestment, and industrial dislocation accompanied by loss of employment. But these problems reflect the inevitable and unforeseeable changes in the socioeconomic structure of the nation, highlighted by shifts from a goods-producing to a service economy, from high-density to low-density population centers in residential preference, from investment concentration in the manufacturing intensive Northeast and Midwest to the South and the Sunbelt. These changes, and the strains that go with them, take time to adjust to and accommodate.

Proponents of this view held that, in the context of transportation, the primary need is to avoid any large-scale interference in or disruption of the existing transportation system. The capital resources required for a major transformation of the system are obviously not available and relatively minor (though still costly) changes have little impact on overall economic development. Accordingly, the approach to be adopted is one of "do no harm" to the existing system. Instead, efforts should be made to gradually remove the negative aspects--regulatory and otherwise--of efficient and competitive transportation performance. This thesis drew virtually unanimous approval from the discussants.

Those who saw a serious economic crisis looming argued that a more aggressive policy than laissez-faire was required. Efficiency in transportation and technological breakthroughs should be actively sought as a means of improving international competitiveness and productivity. A maintenance approach will not serve development and growth objectives. At the same time, the rapid rate of deterioration of the present highly-developed United States transportation system cannot be ignored. Nor can the social and economic costs of further deterioration, disinvestment or abandonment (even if the costs are sectoral, not aggregate) be lightly dismissed. To restore and maintain the system in being places heavy demands on public and private capital resources, and thus imposes hard choices on where and how these resources are to be allocated.

Another major subject of discussion developed from the suggestion that the standard of financial profitability be used to measure transportation efficiency. This view, which was strongly advocated and generally endorsed, held that profitability is the only firm and objective public investment criterion--one that could largely remedy the distortions caused by subsidies. To dissenters who argued that public policy cannot be subordinated to profitability conceded that the use of this standard should not be limited to private sector "bottom line" considerations. Allowances for externalities

and public policy requirements can be introduced through such devices as a "shadow" "revenue stream." However, intelligent funding decisions can be reached only by applying to public investment the same across-the-board costing and pricing tests applied to private sector investment.

Considerable discussion also focused on the diversity of objectives attached to many publicly funded transportation programs. In the view of one participant, often the impression is created that a program is decided upon and then a series of frequently incompatible objectives are set, with a view to satisfying and gaining the support of all affected segments of the community. Participants generally agreed that keying programs to limited, specific objectives would permit more accurate evaluation in planning programs and monitoring their operation.

Also generally accepted was the thesis that essential to good transportation planning is good economic analysis. Decisions on transportation policy must necessarily involve many other factors--social, environmental, psychological, indeed the whole range of issues embodied in the phrase "quality of life"--but arriving at correct decisions cannot be done in the absence of a sound economic analysis base. In developing analysis, efforts should be directed at:

- greater use of empirical evidence; reliance on classical economic theory (e.g., locational theory) can be misleading in situations of change, such as is now being experienced;
- avoidance of single-formula analyses and solutions and more emphasis on a mix of options;
- development of more general models and strategies (carefully selected micro studies can be useful as building blocks);
- clearer definition and refinement of transportation policy objectives and priorities as related to development;
- greater focus on spatial distribution and the sectoral effects of transportation policies;
- more detailed inquiry into the issue of direct and indirect subsidies, the use of financial profitability criteria in evaluating transportation investment choices, and recourse to pricing tools and user-taxes to reflect more closely the costs involved.

The Role of Transportation in Economic Development: Policy Issues and Implications

Panelists and Papers Presented

Robert L. Calhoun, Partner, Sullivan and Worcester, Washington, D.C.

Thomas B. Deen, Executive Director, Transportation Research Board, National Research Council, Washington, D.C.
"Economic Development as a Criterion for Transportation Investment in the U.S."

Michel Frybourg, Director, Institute of Transport Research, Arcueil, France
"Transportation and Economic Development"

Richad Grefe, President, Richard Grefe Associates, Washington, D.C.
"Refining the Policy Objectives in Evaluating Transportation Investments' Economic Development Impacts"

Gerald Kraft, President, Charles River Associates, Boston, Massachusetts

Kenneth Orski, Vice President, The German Marshall Fund, Washington, D.C.

James E. Peterson, Executive Director, National Council for Urban Economic Development, Washington, D.C.

Policy Issues and Implications

Objectives of this workshop were:

- to identify policy issues and implications affecting the decisionmaking process and
- to suggest approaches to future research.

The basic reality of the decisionmaking process is the dominant role of government. As evidenced by the large number of speakers who sought to define this role, the range of government responsibility in the transportation/economic development field is virtually boundless. At one level or another--Federal, State, local--government exercises authority as policymaker, regulator, monitor, investor, operator, keeper of records, referee of disputes, provider of incentives, protector of the underprivileged, distributor of benefits, and so on. Fulfilling all these roles on a complex question such as the transportation/economic development relationship is difficult. Solutions have to be found in trade-offs which are not necessarily related to development or efficiency.

One example given was that while government promotes and encourages technological innovation for efficiency purposes, it subsidizes continued operation of outmoded, inefficient, and costly transportation systems. Another example was the suggestion that mass transit was essentially an instrument of social policy, with redistribution, not growth, as its objective. In effect, what ultimately comes into play in the decisionmaking process is political judgment. A corollary to this is that recommendations based entirely on efficiency or profitability criteria must continually contend with other less quantifiable criteria. Significant changes in systems already in place or in existing subsidy arrangements are difficult to effect.

Substantial increases in highway user taxes, for example, seem unlikely, despite the economic logic of the concept.

Dominance of the public sector in transportation should not result in discounting the possibility of private sector contributions in the form of incentive-encouraged investment and innovation, provision of managerial skill, and public-private cooperative action. The sorry record of publicly-owned urban bus transport and the success reportedly achieved in Buenos Aires and other metropolitan areas through private operation of smaller, more flexible vehicles were noted by several participants and suggest that privatization of selected transport systems deserves much more active consideration.

Another point raised in discussion was that evaluations of public transit investments in urban areas indicate that the impact on employment and income tends to be short-term and concentrated in the construction and early operation stages, and that the impact on land-use patterns is negligible unless supported and reinforced by other, nontransportation programs, such as housing and commercial promotion. A comprehensive integrated approach is needed, involving all agencies, and a set of guidelines should be prepared to assist in determining efficient patterns of development.

A number of suggestions were advanced in terms of broader research techniques and topics. Among these were:

- listings of conceptual difficulties and technical difficulties to be resolved in developing models of transportation/development relations;
- a technique for approaching transportation/economic analyses and determining priority research areas through a four-dimension evaluation: scale of analysis required, level of government interest (Federal, regional, state, local), comprehensiveness of information required, and available policy instruments;
- development of innovative institutional arrangements, particularly in urban transport and land use programs;
- on central city problems, formulation of a comprehensive conceptual framework for using transportation as a tool for development and of a methodology for predicting the development impact of urban transportation programs;
- investigation of the positive and negative effects of over-capacity and redundancy in transportation facilities. What value is attached to them? Do they inhibit development?

TRANSPORTATION SYSTEM SAFETY

Recognizing the lack of consensus regarding transportation safety standards and which programs are most effective and efficient, this segment of the symposium had two objectives: to provide opportunities for information exchange and to guide and stimulate further research on safety. Issues such as the maximum feasible level of safety, how to judge safety performance, the priority of safety relative to other transportation needs, and priorities among safety program options were addressed.

In assessing the state of the art, participants described successful safety techniques to help define a safe transportation system. In discussing performance indicators, various quantitative measures of safety performance were compared. With the ultimate goal of making possible more objective and rational decisions concerning safety, the discussion focused on exploring future research needs and decisionmaking, including the use of performance indicators and the allocation of resources to safety and to other competing objectives.

Transportation System Safety: The State of the Art

Panelists and Papers Presented

B.J. Campbell, Director, Highway Safety Research Center, University of North Carolina, Chapel Hill, North Carolina
"State Highway Safety Programs in the U.S."

Bruce Fine, Director, Office of Planning and Analysis, Federal Railroad Administration, U.S. Department of Transportation, Washington, D.C.

John Flynn, Safety Officer, Washington Metropolitan Area Transit Authority, Washington, D.C.

Louis J. Pignataro, Head, Department of Transportation Planning and Engineering, Polytechnic Institute of New York, Brooklyn, New York
"A Methodology for Transportation Systems Safety"

Eugene Russell, Associate Professor, Kansas State University, Manhattan, Kansas
"Some Thoughts About Determining the Bottom Line for Transportation Accident Reduction Programs"

Martin Wohl, Faculty Fellow (Carnegie-Mellon University), Transportation Systems Center, Cambridge, Massachusetts

State of the Art

Objectives of this workshop were:

- to describe techniques that have successfully incorporated safety into transportation planning and implementation

- to determine what constitutes a safe transportation system.

The general consensus among participants was that safety problems and their causes have not been identified adequately due to the lack of appropriate data. They agreed that evaluation is hampered by the difficulty of calculating the effect of countermeasures, and that existing accident statistics are inadequate diagnostic tools.

One paper described a systematic management approach to safety which laid the groundwork for examining implementation and analysis techniques. The approach involved:

- defining the system;
- determining organizational structure and responsibilities;
- ensuring the flow of information;
- selecting, training, and certifying employees;
- identifying hazards and their control (accident analysis);
- creating a data base for documentation;
- motivating the people involved.

It was suggested that safety programs be considered a high-level staff function, with internal support and guidance.

Considering the implications of this approach raised several questions: Are the procedures complete and rigorous? Are training and certification effective? Is the system of checks and balances adequate? Is increased automation beneficial? Additional factors mentioned as influencing the systematic management approach were labor agreements, operational concerns and managers' expectations, and staffing and equipment.

The author also described some of the quantitative methods that are used to support management through evaluation. One such technique was an intermodal safety index. Using this method, a trip is seen as a sequence of modes. A model is developed, data base structure and requirements are determined, and data is obtained and formatted. However, participants agreed that many variables influence the effectiveness of countermeasures. Behavioral science and human factors engineering were suggested as one way to examine some of these variables.

The systematic approach was presented as an ideal: the possibility of accidents occurring remains unaccountably high. Many highway accidents were considered to be caused in part by road user error and disregard of traffic regulations, but few, if any, transportation safety problems were believed to be well understood or amenable to solution.

Some existing safety methods were said to have had limited success, relying on preventive vehicle design, studies of accident experiences, and historical data. Improved road design, such as the United States interstate highway system, can be a successful preventive measure but may be too costly, as was found in Canada. However, the long-term and unanticipated side effects of most preventive measures remained undetermined, and studying historical data was described as a reactive rather than anticipatory approach. In current

policy, the overriding concern seemed to be with reducing deaths and injuries to innocent parties.

Although comparisons of effectiveness were hampered by the lack of agreed upon standards and the variety of performance measures yielding conflicting results, participants described a few safety techniques and policies, such as seat belt use, passive restraints, and speed reduction, that have emerged as the most successful. Programs examined included: the State and Community Highway Safety Grant Program in the United States; Canada's Cooperative Road Safety Program; and mandatory restraint use in several countries and provinces, including Australia, Scandinavia, the Netherlands, and some Canadian provinces and U.S. States.

The State and Community Highway Safety Grant Program in the United States, which provides Federal grants to States to support innovative highway safety programs, was described as having achieved limited success but suffering from a lack of evaluation and dissemination of results. The National Highway Traffic Safety Administration, while it cannot enforce evaluation requirements, is seriously pursuing the issue of impact evaluation by providing additional technical assistance and offering workshops and symposia to improve State evaluations. However, the accident rate is again increasing primarily due to the continuing influx of smaller, less crashworthy cars made popular by dwindling gasoline supplies. The future was described as bleak in spite of significant progress in occupant safety in recent years. Possible intervention measures include: passive occupant restraints; an expanded State grant program to develop effective, quantifiable programs; and increased support for training, information dissemination, planning, and implementation of safety programs.

The Canadian Cooperative Road Safety Program was described as a comprehensive effort involving the national government and 11 Canadian provinces. Safety divisions were established, coordinators appointed, success monitored, and results disseminated. The program utilized existing countermeasures that were believed could achieve the arbitrarily set goal of a 15% reduction in the fatality rate over five years. The measures chosen were also appropriate to the Canadian situation and politically acceptable. These countermeasures included increased seat belt use in four provinces (comprising 80% of the population), enforceable laws governing driving while intoxicated, removal of road hazards, vehicle standards for trucks and buses, improved vehicle inspection, extended driver education, increased police presence, motorcycle helmet regulations, and reduced speed limits. The selections and various combinations of measures used were based on expert judgment, the results of a NATO study on road safety, and existing priorities in the provinces. The cost of each measure was also considered. Evaluators determined effectiveness through surveys of seat belt use, roadside surveys of impaired drivers, police statistics, fatality rates, coroner's reports, and crashworthiness evaluations. The program was credited with reducing fatalities substantially. The fatality rate per vehicle-kilometer declined 33% in the first year. Significantly fewer impaired drivers died.

While the reduction in the fatality rate cannot be attributed solely to the first program, it prompted the adoption of a second, more elaborate

program aimed primarily at increasing seat belt use. The second program is still being monitored; however, preliminary data indicate that its effectiveness is limited.

The process by which the program was framed and the program itself were reported to have effected changes in Canadian institutions involved in the establishment and implementation of safety countermeasures. The Council of Ministers is officially responsible for meeting safety goals. Researchers are brought closer to the policymaking process, and policymakers better understand the trade-offs and alternatives available to them.

Australia was the first country to legislate and subsequently enforce compulsory seat belt use. Installation was required in all seats, and occupants not wearing seat belts were fined. A highly significant reduction in the fatality rate followed. About 25 countries have adopted such regulations, and where they have been enforced, seat belt use has increased. Non-wearers of seat belts not only increased their exposure to risk of injury, but also were found to have more accidents. In Scandinavian countries, mandatory seat belt use and laws requiring motorcycle and moped riders to wear helmets have been found to be effective. In Switzerland, fatalities decreased following enactment of legislation requiring seat belt use and rose again when the law was repealed. Following seat belt legislation, highway fatalities declined by 18%, while days of incapacitation for front-seat occupants declined by 30%.

Transportation System Safety: Performance Indicators and Data Requirements

Panelists and Papers Presented

Erik Asmussen, Director, Institute for Road Safety Research, Voorburg, Netherlands
"A Model of the Accident Process as a Tool to Develop Indicators for Transportation System Safety and Traffic Risks"

Robert J. Forman, Vice President for Safety and Security, Trailways, Inc., Dallas, Texas

Aaron Gellman, President, Gellman Research Associates, Inc., Jenkintown, Pennsylvania

Christer Hyden, Department of Traffic Planning and Engineering, University of Lund, Sweden
"An Effective Speed Reduction as a General Traffic Safety measure in Urban Traffic"

Niels O. Jorgensen, Professor, Institute of Roads, Traffic, and Town Planning, Technical University of Denmark, Lyngby, Denmark
"The Risk Concept in Road Safety Work"

Robert Voas, Director, Office of Program and Demonstration Evaluation, National Highway Traffic Safety Administration, U.S. Department of Transportation, Washington, D.C.

Performance Indicators and Data Requirements

The objective of this workshop was to identify those indicators or measures of transportation safety performance which could be employed to determine the effectiveness of a safety system. Participants identified several purposes of performance indicators:

- to link the transportation system to the social system;
- to allow comparison with other threats in society;
- to measure the number of people involved in accidents;
- to measure accident severity, which is linked to theories of human tolerance;
- to measure total unsafety, that is, the number of casualties as a percent of the number of people involved, considering mobility, occupancy, accident complexity, accident occupancy, and accident severity.

One presentation described an accident model for a given situation utilizing:

- input indicators, such as the number of approaching vehicles;
- process indicators, such as provoked traffic behavior (provoked, for example, by the speed limit);
- output indicators, for example, the number of cars involved in an accident.

It was pointed out that output indicators usually express risk but are often insufficient. Examples given included the number of casualties per vehicle-kilometer and the number of fatal accidents per vehicle-kilometer. Both were faulted for failing to distinguish between single- and multi-occupant vehicles. Another output indicator--the number of people involved--was proposed to link the transportation system to the social system to allow comparison with other threats in society.

Studying the causes of accidents often leads to behavioral studies to evaluate changes in driver behavior, for example, as a result of seat belt use. Here the study emphasis is on the driver rather than the vehicle.

These points were addressed in a discussion of a speed reduction experiment in Sweden. Poor driver/pedestrian interaction due to excessive vehicle speed was deemed to be a major cause of accidents. Safety measures such as

signalization and pedestrian overpasses and underpasses proved ineffective. The experiment described involved speed-reducing mounds constructed at an uncontrolled intersection to reduce speed and thereby allow more time for driver-pedestrain and driver-driver interaction. The number of serious accidents was reported to drop significantly.

To avoid the pitfalls of basing evaluations on accident statistics, the safety effect of this experiment was measured indirectly using the Traffic Conflicts Technique (TCT). The TCT, developed in 1976, was described as based on the assumption that a positive correlation exists between serious accidents and policy reports of injuries and accidents. The technique allows safety studies to be conducted during a very short period of time and to describe behaviors and events preceding an accident.

Another technique presented was risk analysis which is oriented toward accident prediction and involves determining the relationship between risk, mobility, and resources. An accident was described as the result of the operation of many influences. Several techniques for estimating risk were pointed out involving the use of different variables. For instance, calculating the number of injured moped riders per year as a proportion of inhabitants allows comparison with other health risks, such as disease. A statistic such as the number injured per moped-kilometer was suggested as a measure of tne quality of the traffic system.

The author classified several types of risks. A relative systems risk objective sets the level of acceptable risk according to the risk caused by the road user. An absolute systems risk objective states a specific, maximum acceptable risk or sets specific targets. A relative social risk objective compares transportation safety risks to other types of risk, such as the danger of accidents in the home or in industry.

On the other hand, risk analysis was characterized as designed to examine a specific incident and not lending itself to system-wide application. Another factor affecting the approach to risk estimation is public attitude, that is, what situations are perceived to be unsafe and to what extent. This may be influenced by media reporting.

Catastrophic accidents, which present additional problems for evaluation, were the subject of another presentation. Statistical methods cannot be used in studying rare events because the small number of cases adversely affects statistical significance. Alternative methods suggested were the examination of sources of transportation hazards rather than their causes and the measurement of margin of safety at certain points in the transportation process to identify the weak points.

In the ensuing discussion of these presentations, three measurement levels were identified. At the metalevel, or generalized structural approach, is a study of the accident process. At the theoretical level, process phases are examined, leading to hypotheses of causality. At the operational level, statistical indicators are used to identify correlations.

The participants also concentrated on a problem which is basic to the design and use of performance indicators. Before effectiveness measures can be utilized, it was suggested that goals and targets be set by which to measure success and determine acceptable levels, efforts, and costs. Process evaluations were suggested to identify key issues, produce a preliminary methodology, test applications in case studies, and then refine and generalize the guidelines. Cost-benefit, cost-effectiveness, and cost-utility studies, as well as resource allocation studies, were considered necessary to create a relevant data base in addition to recording available historical data. One limitation of such studies that was pointed out is the difficulty of measuring the benefits of safety. Some discussants felt strongly that cost should not become the sole or primary consideration. An example offered was a study in the United Kingdom which revealed that, from a cost point of view, safety programs aimed toward middle-aged people would be more cost-beneficial because the socioeconomic losses resulting from their deaths are greater than those resulting from the death of very young or very old people. From a policy point of view, however, such a program would be unacceptable.

A final need expressed was for the dissemination of research results to help promote a consensus as to approach and effectiveness.

Transportation System Safety: Policy Issues and Implications

Panelists and Papers Presented

Veli Himanen, Special Research Officer, Technical Research Center of Finland, Road and Traffic Laboratory, Espoo, Finland
"Individual and Governmental Choices Between Freedom and Safety"

Thomas Moore, Senior Fellow, The Hoover Institution, Stanford, California

Jeremiah H. O'Driscoll, Manager, Planning-Safety, Southern Railway System, Atlanta, Georgia

William D. Rowe, Director, Institute for Risk Analysis, The American University, Washington, D.C.
"Problems in Estimating the Potential for Transportation Catastrophes"

S.C. Wilson, Countermeasures Development, Road and Motor Vehicle Traffic Safety Branch, Transport Canada, Ottawa, Canada
"Canada's Co-operative Road Safety Program"

Policy Issues and Implications

Objectives of this workshop were:

- to identify research needed to improve transportation safety decisions;

- to consider allocations of resources between safety and other competing objectives;

- to determine how performance indicators can be used to increase objectivity and rationality in decisionmaking.

One participant predicted that mass-velocity divergence--the difference between the size and speed of trucks compared to that of cars--will increase due to the influx of smaller, slower cars; safety programs will be more vigorously marketed; and more safety regulation, both public and private, will be instituted.

A fear was expressed that policy decisions have been and will continue to be made in the face of uncertainty. Problem analysis--deciding what process to control, why and how it should be controlled, and who should control what and where--is needed to help discern and establish priorities. A participant suggested that the public and policy implementors should be educated about risks and safety and that communication between the public, researchers, and policymakers should be encouraged. A need was also expressed to broaden the range of variables considered, particularly to include behavioral factors. An important issue was what approach to take with transportation system users who disregard policy and regulations.

A central issue in discussing policy issues and implications was society's determination of what casualty rate is acceptable. One presenter suggested moving away from a cost-effectiveness approach toward estimating probable risk in a given system, thus enabling policymakers to establish criteria to determine where to invest funds and evaluate effectiveness. It was noted that since the 1930s, increased expenditures were followed by decreased accident and fatality rates; when funds were cut back, the rates rose again.

Funding for safety in the transportation of hazardous materials was offered as an example of the disparity between funds allocated and the death rate from accidents. While hazardous materials accidents attract much attention, the death rate is minimal. It was pointed out that the benefits of transporting hazardous materials, such as an improved standard of living, should also be considered. Another example discussed was a study which ranked rail-highway grade crossings by the risk associated with each to provide a basis for allocating funds.

In summarizing this presentation, several conclusions were drawn:

- Risk, mobility, and resource relationships should be further developed.

- Risk analysis should be applied to rare and unpredictable events.

- Risk models should be more credible, applicable on a system-wide basis and understood by safety professionals and the public.

This last point was suggested to help minimize the disparity between real and perceived risk.

A second crucial element of policymaking which was examined was the distinction between social considerations and private considerations and their occasional incompatibility. These issues were addressed in a presentation on the choices individuals and governments make between freedom and safety. To increase safety, government frequently must reduce the individual's freedom of movement. Behavioral studies indicate that, for regulation to be successful, people need to perceive the benefits of governmental controls. People are, as a rule, willing to sacrifice more freedom of movement as the perceived risk obviously increases. They will seek to expand freedom if risk is not increased. Similarly, people were said to be more willing to obey regulations if freedom is restricted for those exposed to the risk.

The discussion continued on the various ways in which performance indicators are designed and used, and how different methods of risk estimation lead to different political decisions. The variation between intended user behavior and actual user behavior was seen as pointing toward behavioral studies as more appropriate tools. Industry-imposed regulation, such as insurance practices and the effects of media reporting, should also be considered.

Inasmuch as existing research indicates that some safety measures are successful, one policy alternative suggested was to make wider use of those measures, such as mandatory installation and use of passive occupant restraints and seat belts. Stricter driver and road user regulation was considered desirable, although some questioned the extent to which management of transportation systems can be altered due to other variables, such as vehicle condition, driver competence, and local regulations and attitudes. Reduced speed limits were also reported to be successful.

Some participants stressed an urgent need to set goals, standards, and priorities to help determine appropriate and feasible policy alternatives. Setting standards would enable decisionmakers to formulate policy and objectives by considering the types of risk to be tolerated. Thus, appropriate types of risk could be targeted.

An anticipatory policy which examines the process rather than the consequences of accidents was considered by some to be more effective than reactive policy. For instance, an anticipatory catastrophe strategy is a mixture of prevention, mitigation, and disaster relief.

It was further suggested that policymakers be held accountable for meeting safety goals and be provided with an adequate system of checks and balances. As components of the policy process, complete and rigorous safety system procedures, effective training and certification of safety personnel, and careful consideration of the pros and cons of further automation were mentioned as contributing to the success of transportation safety policy.

List of Participants

Dr. W. Bruce Allen, Associate Professor
Regional Science and Transportation Department
University of Pennsylvania
3718 Locust Street
Philadelphia, Pennsylvania 19104

Ms. Karen B. Alschuler, Urban Planner
Associate
Skidmore, Owings and Merrill
334 Boylston Street
Boston, Massachusetts 02116

Mr. Norman W. Arnold, President
M and H Services, Inc.
2699 South Bayshore Drive, 900-E
Miami, Florida 33133

Mr. Ir E. Asmussen, Director
Institute for Road Safety Research (SWOV)
P.B. 170
2260 AD Leidschendam,
The Netherlands

Dr. Gerard Aurbach
Deputy to the Secretary General
European Conference of Ministers
of Transport (ECMT)
19 rue de Franqueville
75775 Paris, Cedex 16, France

Mr. Charles D. Baker, Chairman
Harbridge House, Inc.
11 Arlington Street
Boston, Massachusetts 02116

Mr. Philip J. Barbato, Research Analyst
Economic Studies Division (P-38)
U.S. Department of Transportation
400 Seventh Street, S.W.
Washington, D.C. 20590

Mr. Bruce Barkley, Director
Office of Management Planning (M-20)
U.S. Department of Transportation
400 Seventh Street, S.W.
Washington, D.C. 20590

Ms. Lana R. Batts, Director
Energy and Economics
American Trucking Associations, Inc.
1616 P Street, N.W.
Washington, D.C. 20036

Mr. A. Jeff Becker, Manager
Service Development
Tidewater Regional Transit
509 E. 18th Street
P.O. Box 660
Norfolk, Virginia 23501

Mr. David Z. Beckler, Director
District I
Organization for Economic Cooperation and
Development
2 Rue Andre-Pascal
75016 Paris, France

Mr. Howard Bellinger, Director
Metropolitan Planning Commission
P.O. Box 1027
Savannah, Georgia 31402

Dr. Salvatore Bellomo, President
BKI Associates, Inc.
Two Tysons Corner Center Office Building
McLean, Virginia 22102

Honorable E.J. Benson, President
Canadian Transport Commission
Ottawa, Ontario
Canada K1A ON9

Mr. Eric W. Beshers, Deputy Director
Office of Economic Analysis and Public
Investment (P-31)
U.S. Department of Transportation
400 Seventh Street, S.W.
Washington, D.C. 20590

Dr. Robin Bidwell, Research Director
Environmental Resources Limited
79 Baker Street
London W1M 1AJ, England

Mr. Stephen E. Blake, Environmental Specialist
Transportation Research Board
2101 Constitution Avenue, N.W.
Washington, D.C. 20418

Ms. Carolyn Blum, Procurement Analyst
Office of Installations and Logistics (M-60)
U.S. Department of Transportation
400 Seventh Street, S.W.
Washington, D.C. 20590

BEST DOCUMENT AVAILABLE

Dr. Philip H. Bly
Transport and Road Research Laboratory
Old Wokingham Road
Crowthorne, Berkshire
RG11 6AU, England

Mr. George A. Bonina
Environmental Protection Specialist
Environmental Protection Agency
401 M Street, S.W.
Washington, D.C. 20460

Mr. Lynn Bradford
Associate Administrator for Enforcement
National Highway Traffic Safety
Administration (NEF-01)
U.S. Department of Transportation
400 Seventh Street, S.W.
Washington, D.C. 20590

Mr. Richard H. Bradley, Deputy Commissioner
Bureau of Public Transportation
Connecticut Department of Transportation
24 Wolcott Hill Road
P.O. Drawer A
Wethersfield, Connecticut 06109

Mr. Thomas W. Brahms, Executive Director
Institute of Transportation Engineers
525 School Street, S.W., Suite 410
Washington, D.C. 20024

Mr. Daniel Brand, Vice President
Charles River Associates
200 Clarendon Street, 44th Floor
Boston, Massachusetts 02116

Mr. Richard C. Brooks
Operations Research Analyst
Research and Special Programs
Administration (B-27)
U.S. Department of Transportation
400 Seventh Street, S.W.
Washington, D.C. 20590

Mr. William F. Brown, Deputy Director
University Research Office (DPB-51)
U.S. Department of Transportation
400 Seventh Street, S.W.
Washington, D.C. 20590

Mr. Richard Brumback, Director
Analytical Services Division
Wilson-Hill Associates, Inc.
1025 Vermont Avenue, N.W.
Washington, D.C. 20005

Mr. Don Bryan, Deputy Secretary
Local and Area Transportation
Pennsylvania Department of Transportation
1207 Transportation and Safety Building
Harrisburg, Pennsylvania 17120

Mr. W.J. Burns, Associate Director
Office of Industry Policy (P-12)
U.S. Department of Transportation
400 Seventh Street, S.W.
Washington, D.C. 20590

Mr. Robert L. Calhoun
Sullivan & Worchester
1025 Connecticut Avenue, N.W.
Washington, D.C. 20036

Dr. B.J. Campbell, Director
Highway Safety Research Center
CTP - 197A
University of North Carolina
Chapel Hill, North Carolina 27514

Mr. Ian C. Campbell, Executive Director
Research and Development Division
Ontario Ministry of Transportation
and Communications
1201 Wilson Avenue, East Building
Downsview, Ontario
Canada M3M 1JB

Mr. Joseph Canny, Chief
Environmental Analysis Division (P-22)
U.S. Department of Transportation
400 Seventh Street, S.W.
Washington, D.C. 20590

Dr. Edmund J. Cantilli
Polytechnic Institute of New York
333 Jay Street
Brooklyn, New York 11201

Mr. Lou Capaldi, Chief Planner
Stark County Area Transportation Study
511 County Office Building
Canton, Ohio 44702

Mr. C. Carroll Carter, Publisher and Editor
MASSTRANSIT
555 National Press Building
Washington, D.C. 20045

Mr. Robert D. Christian, Division Manager
ENSCO, Inc.
2560 Huntington Avenue
Alexandria, Virginia 22303

Mr. Sherwood C. Chu, Director
University Research Office (DPB-20)
U.S. Department of Transportation
400 Seventh Street, S.W.
Washington, D.C. 20590

Mr. Adrian B. Clary, Engineer of Maintenance
Transportation Research Board
2101 Constitution Avenue, N.W.
Washington, D.C. 20418

BEST DOCUMENT AVAILABLE

Ms. Camille H. Cleveland
Environmental Program Analyst
Office of Environment and Safety (P-22)
400 Seventh Street, S.W.
Washington, D.C. 20590

Ms. Judith T. Connor
Assistant Secretary for Policy
and International Affairs
U.S. Department of Transportation
400 Seventh Street, S.W.
Washington, D.C. 20590

Mr. Martin Convisser, Director
Office of Environment and Safety (P-20)
U.S. Department of Transportation
400 Seventh Street
Washington, D.C. 20590

Mr. Kenneth E. Cook, Economist
Transportation Research Board
2101 Constitution Avenue, N.W.
Washington, D.C. 20410

Mr. Norman Cooper, Program Coordinator
Environmental Coordination Division (P-23)
U.S. Department of Transportation
400 Seventh Street, S.W.
Washington, D.C. 20590

Mr. James Costantino, Director
Transportation Research Center (DTS-1)
U.S. Department of Transportation
Kendall Square
Cambridge, Massachusetts 02142

Ms. Maureen Craig, Program Coordinator
Environmental Coordination Division (P-23)
U.S. Department of Transportation
400 Seventh Street, S.W.
Washington, D.C. 20590

Mr. Robert Crecco
Environmental Affairs Specialist
Environmental Analysis Division (P-22)
U.S. Department of Transportation
400 Seventh Strteet, S.W.
Washington, D.C. 20590

Mr. Robert Crosby
Office of Systems Engineering (DPB-20)
Research and Special Programs Administration
U.S. Department of Transportation
400 Seventh Street, S.W.
Washington, D.C. 20590

Ms. Antoinette d'Aspremont, CIM Research Fellow
Catholic University of Louvain
Institute of Administration and
Management
Avenue de l'Espinette 16
1348 Louvain-la-Neuve, Belgium

Ms. Pippa de Cosson, Research Officer
Urban Transit Authority of British Columbia
P.O. Box 610
844 Courtney Street
Victoria, British Columbia
Canada V8W 2P3

Mr. V.J.D. de Groot, Deputy Head
Department of Roads and Bridges
Ministry of Transport
Van Naeltwijckstraat 17
2241 J.M. Wassenaar, The Netherlands

Mr. Thomas B. Deen, Executive Director
Transportation Research Board
2101 Constitution Avenue, N.W.
Washington, D.C. 20418

Mr. Joseph Delahanty, Chief
Special Projects Planning Staff (NPP-30)
National Highway Traffic Safety Administration
U.S. Department of Transportation
400 Seventh Street, S.W.
Washington, D.C. 20590

Mr. Pieter de Man
Secretary General
Ministry of Transport and Public Works
Plesmanweg 1-6
The Hague, The Netherlands

Mr. Kennerly H. Digges
Associate Administrator for Research
and Development (NRD-01)
National Highway Traffic Safety
Administration
U.S. Department of Transportation
400 Seventh Street, S.W.
Washington, D.C. 20590

Mr. Thomas Domencich, Consultant
SOMET Associates
RFD #3, Middlesex Center
Montpelier, Vermont 05602

Ms. Helen Doo, Policy Analyst
Office of Transportation Economic Analysis (P-33)
U.S. Department of Transportation
400 Seventh Street, S.W.
Washington, D.C. 20590

Mr. Howard Dugoff, Administrator
Research and Special Programs
Administration (DRP-1)
U.S. Department of Transportation
400 Seventh Street, S.W.
Washington, D.C. 20590

Mr. Michael V. Dyett, Principal
Blayney-Dyett
177 Post Street, #750
San Francisco, California 94108

BEST DOCUMENT AVAILABLE

Ms. Nancy T. Ebersole, Program Analyst
Energy Policy Division (P-36)
U.S. Department of Transportation
400 Seventh Street, S.W.
Washington, D.C. 20590

Mr. John E. Ebinger, Senior Associate
Wilbur Smith and Associates
Banker's Trust Towers
P.O. Box 92
Columbia, South Carolina 29202

Mr. Sheldon Edner
Department of Political Science
Portland State University
P.O. Box 751
Portland, Oregon 97207

Mr. Peter Eggleton, Executive Director
Transportation Development Center
1000 Sherbrooke West
P.O. Box 549
Montreal, Quebec
Canada H3A 2R3

Mr. Earl Eisenhart
Administrative Assistant
American Association of Motor Vehicles Administration
1201 Connecticut Avenue, N.W.
Washington, D.C. 20036

Mr. Eric Ekers
OECE
1750 Pennsylvania Avenue, N.W.
Washington, D.C. 20006

Mr. Rod Engelen, Senior Vice President
Barton-Aschman Associates, Inc.
820 Davis Street
Evanston, Illinois 60201

Dr. Edward Epremian, Executive Director
Commission on Sociotechnical Systems
National Academy of Sciences
2101 Constitution Avenue, N.W.
Washington, D.C. 20418

Mr. Ulrich F. W. Ernst
Senior Research Associate
The Urban Institute
2100 M Street, N.W.
Washington, D.C. 20037

Mr. John Eymonerie
International Cooperation Division (P-45)
U.S. Department of Transportation
400 Seventh Street, S.W.
Washington, D.C. 20590

Dr. Robert L. Fairman
Assistant Secretary for Administration (M-1)
U.S. Department of Transportation
400 Seventh Street, S.W.
Washington, D.C. 20590

Mr. Paul Farragut
Maryland Department of Transportation
P.O. Box 8755
Baltimore/Washington International Airport
Baltimore, Maryland 21240

Dr. John J. Fearnsides
Director of Planning and Policy Studies
The MITRE Corporation
1820 Dolly Madison Boulevard, W300
McLean, Virginia 22102

Mr. Barry Felrice
Associate Administrator for Plans and Programs (NPP-01)
National Highway Traffic Safety Administration
U.S. Department of Transportation
400 Seventh Street, S.W.
Washington, D.C. 20590

Mr. Douglas Fergusson, Director
Safety Services
Nationwide Insurance Co.
One Nationwide Plaza
Columbus, Ohio 43216

Mr. Thomas F. Ferrara, Chief
Resource Allocation and Analysis Division (RRI-31)
Federal Railroad Administration
U.S. Department of Transportation
400 Seventh Street, S.W.
Washington, D.C. 20590

Dr. G.J. Fielding, Director
Institute of Transportation Studies
University of California at Irvine
Irvine, California 92717

Mr. Bruce Fine, Director
Office of Planning and Analysis (RRS-30)
Federal Railroad Administration
U.S. Department of Transportation
400 Seventh Street, S.W.
Washington, D.C. 20590

Mr. Michael Finkelstein
Associate Administrator for Rulemaking (NRM-01)
National Highway Traffic Safety Administration
U.S. Department of Transportation
400 Seventh Street, S.W.
Washington, D.C. 20590

Mr. Ronald J. Fisher, Director
Office of Service and Methods Demonstration (UPM-30)
Urban Mass Transportation Administration
U.S. Department of Transportation
400 Seventh Street, S.W.
Washington, D.C. 20590

Mr. John Flynn, Safety Officer
Washington Metropolitan Area Transit Authority
600 Fifth Street, N.W.
Washington, D.C. 20001

BEST DOCUMENT AVAILABLE

Mr. Robert J. Forman, Vice President
Safety and Security
Trailways, Inc.
1500 Jackson Street, Suite 413
Dallas, Texas 75201

Mr. Jack Francis, Program Coordinator
Environmental Analysis Division (P-22)
U.S. Department of Transportation
400 Seventh Street, S.W.
Washington, D.C. 20590

Ms. Carolyn Frank, Senior Economist
Automated Sciences Group, Inc.
700 Roeder Road
Silver Spring, Maryland 20910

Dr. Michel Frybourg, Director
Institut de Recherche des Transports,IRT
2, Avenue Malleret-Joinville - BP. 34
94114 Arcueil Cedex, France

Mr. Rudolph Gabler, Assistant Director
Ministry of Transportation
Kennedyalle 72
D-5300 Bonn 2
Federal Republic of Germany

Dr. Ralph Gakenheimer
Department of Urban Planning
Massachusetts Institute of Technology
77 Massachusetts Avenue, Room 3-415
Cambridge, Massachusetts 021.9

Mr. Jose Carlos Garcia-Hernandez
Delegate, Department of Traffic and Transport
Municipality of Madrid
Plaza de la Villa, 4
Madrid, Spain

Dr. Aaron J. Gellman, President
Gellman Research Associates, Inc.
Beaver Hill South
100 West Avenue
Jenkintown, Pennsylvania 19046

Dr. G. A. Giannopoulos
Professor of Transportation Engineering
University of Salonica
1 Arginouson Street
Athens 808, Greece

Mr. R. N. Girdhar, Senior Program Planner
Ontario Ministry of Transportation and
Communications
Transit Office
3rd Floor, West Tower
1201 Wilson Avenue
Downsview, Ontario, Canada

Dr. Michael A. Goldberg
Faculty of Commerce and Business Administration
University of British Columbia
Vancouver, British Columbia
Canada V6T 1Y8

Mr. Jose A. Gomez-Ibanez
Senior Staff Economist
Council of Economic Advisers
Old Executive Office Building
Washington, D.C. 20506

Mr. W.C. Graeub
Engineer of Public Transportation
Transportation Research Board
2101 Constitution Avenue, N.W.
Washington, D.C. 20418

Mr. Sigurd Grava, Vice President
Parsons Brinckerhoff
One Penn Plaza
New York, New York 10119

Mr. Jean J.O. Gravel, Director General
Transport Canada
Tower C, Place de Ville
Ottawa, Ontario
Canada K1A ON5

Mr. Erick S. Graye
Howard University
2300 Sixth Street, N.W.
Washington, D.C. 20010

Mr. Richard Grefe, President
Richard Grefe Associates
731 - 8th Street, S.E.
Washington, D.C. 20003

Mr. William C. Grenke
Planning and Safety Director
Roy Jorgensen Associates, Inc.
P.O. Box 3310
Gaithersburg, Maryland 20760

Mr. Odd Gulbrandsen, Research Leader
The Institute of Transport Economics
Grensevn 86
Oslo 6, Norway

Dr. S. Olof Gunnarsson
Department of Traffic and Urban Planning
Chalmers University of Technology
S-41296 Goteberg, Sweden

Mr. Herb Guth, Aviation Specialist
Transportation Research Board
2101 Constitution Avenue, N.W.
Washington, D.C. 20418

Mr. Stanley Gutkowski
Administrative Services Manager
Arthur Andersen & Company
1666 K Street, N.W.
Washington, D.C. 20006

Dr. Irving Hand
Professor of State and Regional Planning
Pennsylvania State University
Capitol Campus
Middletown, Pennsylvania 17057

BEST DOCUMENT AVAILABLE

Dr. Royce Hanson, Project Manager
Committee on National Urban Policy
National Research Council (J.H. 504)
2101 Constitution Avenue, N.W.
Washington, D.C. 20418

Mr. Edwin L. Harper
Deputy Director
Office of Management and Budget
Executive Office Building
Washington, D.C. 20503

Mr. N. Thomas Harris
Assistant to the President
American Trucking Associations, Inc.
1616 P Street, N.W.
Washington, D.C. 20036

Mr. Frank L. Hassler, Director
Systems Research and Analysis (DTS-20)
Transportation Systems Center
U.S. Department of Transportation
Kendall Square
Cambridge, Massachusetts 02142

Mr. Winslow Hayward
The Futures Group
1029 Vermont Avenue, N.W.
Washington, D.C. 20005

Mr. William F. Hein, Deputy Executive Director
Metropolitan Transportation Commission
Hotel Claremont
Berkeley, California 94705

Mr. David J. Hensing
Assistant to the Director
AASHTO
444 North Capital Street, N.W.
Washington, D.C. 20001

Dr. Robert S. Herman, Director
Institute for Traffic Management and Research
411 State Street
Albany, New York 12203

Mr. William I. Herman, Director
Financial and Policy Planning
Washington Metropolitan Area Transit Authority
600 5th Street, N.W.
Washington, D.C. 20001

Mr. Veli Himanen, Research Officer
Technical Research Center of Finland
Road and Traffic Laboratory
Revontulentie 7, 02100 Espoo
Finland

Mr. James M. Holec, Jr., Manager
Peat, Marwick, Mitchell and Company
1990 K Street, N.W.
Washington, D.C. 20006

Mr. W. J. Holt, Chief
Vehicle Engineering Research Division (NRM-12)
National Highway Traffic Safety Administration
U.S. Department of Transportation
400 Seventh Street, S.W.
Washington, D.C. 20590

Mr. George Hoogenboom
Ministry of Transport and Public Works
Koninginnegracht 19-21
P.O. Box 20901
2500 EX, The Hague, Netherlands

Mr. Burkhard Horn, Principal Administrator
Road Research Secretariat
Organization for Economic Cooperation and Development
2 Rue Andre Pascal
Paris 16e, France

Dr. Wim Horn, Director
Study Department
Ministry of Transport and Public Works
Bleyenburg 25
2678 De Lier, The Netherlands

Mr. Michael Horodniceanu, Vice President
Urbitran Associates, Inc.
15 Park Row
New York, New York 10038

Mr. Bradford C. Houser, Deputy Manager
Jet Propulsion Laboratory
California Institute of Technology
4800 Oak Grove Drive - M/S 502/307
Pasadena, California 91103

Mr. Donald R. Hoyte, Senior Legislative Analyst
Legislative Commission on Critical Transportation
Choices
Legislative Office Building (Room 811)
Albany, New York 12247

Dr. Ti Hsu
Department of Management
Rutgers University
77 Hamilton Street
New Brunswick, New Jersey 08903

Mr. Christer Hyden, Research Leader
Department of Traffic Planning and Engineering
University of Lund
Box 725
S-220 07 Lund, Sweden

Mr. Donald J. Igo, Chief
Energy Policy Division (P-36)
U.S. Department of Transportation
400 Seventh Street, S.W.
Washington, D.C. 20590

BEST DOCUMENT AVAILABLE

Mr. Paul Irick
Assistant Director for Special Projects
National Research Council
Transportation Research Board
2101 Constitution Avenue, N.W.
Washington, D.C. 20418

Mr. Lowell B. Jackson
Secretary of Transportation
Wisconsin Department of Transportation
State Office Building
1208 HFS08, Box 7910
Madison, Wisconsin 53707

Mr. Crawford F. Jencks, Projects Engineer
Transportation Research Board
2101 Constitution Avenue, N.W.
Washington, D.C. 20418

Mr. K.B. Johns
Assistant Director for Technical Activities
Transportation Research Board
2101 Constitution Avenue, N.W.
Washington, D.C. 20418

Professor Neils O. Jorgensen
Institute of Roads, Traffic and Town Planning
Technical University of Denmark
Building 115
DK-2800 Lyngby, Denmark

Mr. Joep J. M. Jurgens
Counselor for Transportation
Royal Netherlands Embassy
4200 Linnean Avenue, N.W.
Washington, D.C. 20008

Dr. David Kahn
Office of Systems Research and Analysis (DTS-20)
Transportation Systems Center
U.S. Department of Transportation
Kendall Square
Cambridge, Massachusetts 02142

Dr. John F. Kain
City and Regional Planning Program
Harvard University
Gund Hall 312
48 Quincy Street
Cambridge, Massachusetts 02139

Mr. Mart Kask, Executive Director
Puget Sound Council of Governments
Grand Central on the Park
216 First Avenue South
Seattle, Washington 98104

Mr. R. Ian Kingham, Senior Staff Officer
Transportation Research Board
2101 Constitution Avenue, N.W.
Washington, D.C. 20418

Mr. Ronald F. Kirby
Director of Transportation Studies
The Urban Institute
2100 M Street, N.W.
Washington, D.C. 20037

Dr. P. Robert Knaff, Director
Office of Driver and Pedestrian Research (NRD-40)
National Highway Traffic Safety Administration
U.S. Department of Transportation
400 Seventh Street, S.W.
Washington, D.C. 20590

Dr. Hermann Knoflacher, Professor
Institute of Traffic Safety
A 1030 Vienna
Olzeltgasse 3, Austria

Dr. Ilja Kordi, Chief Consultant
Prognoskonsult AB
Klubbvagen 5
S-182 31 Danderyd, Sweden

Ms. Kathleen M. Koss, Transportation Specialist
Environmental Coordination Division (P-23)
U.S. Department of Transportation
400 Seventh Street, S.W.
Washington, D.C. 20590

Mr. Gerald Kraft, President
Charles River Associates, Inc.
200 Clarendon Street
Boston, Massachusetts 02116

Ms. Michele Krasner
Transportation Project Manager
National Council for Urban Economic Development
1730 K Street, N.W.
Washington, D.C. 20006

Mr. Armando Lago, President
Ecosometrics, Inc.
4715 Cordell Avenue
Bethesda, Maryland 20014

Mr. Leiv Landro, Senior Engineer
Ministry of Environment
P. O. Box 8013
N - Oslo 1, Norway

Mr. Leon N. Larson, Director
Office of Environmental Policy (HEV-10)
Federal Highway Administration
U.S. Department of Transportation
400 7th Street, S.W.
Washington, D.C. 20590

Mr. Henning Lauridsen
Chief Research Engineer
Institute of Transport Economics
P.O. Box 6110 Etterstad
N - Oslo 6, Norway

BEST DOCUMENT AVAILABLE

Mr. Roy Lave, Chairman
Systan, Inc.
P.O. Box U
Los Altos, California 94022

The Honorable Drew Lewis
Secretary of Transportation
400 Seventh Street, S.W.
Washington, D.C. 20590

Mr. Julius Lindblom
Automatish Doserings
Kompersater AB, Manhemen sv. 11A
Sollentuna, Sweden

Mr. Tore Lindholt, Chief Director
Management and Finance
Norwegian State Railways
Storgt 33
N - Oslo 1, Norway

Mr. Charles F. Livingston
Associate Administration for Traffic
Safety Programs (NTS-01)
National Highway Traffic Safety Administration
U.S. Department of Transportation
400 Seventh Street, S.W.
Washington, D.C. 20590

Mr. Manuel Losada-Garcia
RENFE
Direccion de Planificacion
Final Avda Pio XII, s/n
Est. Chamartin
Madrid 16, Spain

Mr. George McDonald, Program Coordinator
Environmental Coordination Division (P-23)
U.S. Department of Transportation
400 Seventh Street, S.W.
Washington, D.C. 20590

Mr. Charles McGuire
Office of Policy and International Affairs (P-5)
U.S. Department of Transportation
400 Seventh Street, S.W.
Washington, D.C. 20590

Mr. Harold McLaughlin, Manager
Economics Division
Port Authority of New York and New Jersey
1 World Trade Center, 715
New York, New York 10048

Mr. Gerry McMillan, Head
Program Development
Ontario Ministry of Transportation and
Communications
Transit Office, 3rd Floor, West Tower
1201 Wilson Avenue
Downsview, Ontario, Canada

Mr. James McQueen, Director
Office of Intercity Planning (UPM-13)
Urban Mass Transportation Administration
U.S. Department of Transportation
400 Seventh Street, S.W.
Washington, D.C. 20590

Dr. Voyce Mack, Deputy Director
Office of International Policy and Programs (P-41)
U.S. Department of Transportation
400 Seventh Street, S.W.
Washington, D.C. 20590

Mr. Roger L. Mackett
Senior Research Fellow
The University of Leeds
Institute of Transport Studies
Leeds, LS2 9JT, United Kingdom

Mr. R. A. Makofski, Group Supervisor
Johns Hopkins Applied Physics Laboratory
Johns Hopkins Road
Laurel, Maryland 20810

Dr. Marvin L. Manheim, Head
Transportation Systems Division
Massachusetts Institute of Technology
77 Massachusetts Avenue (Room 1-163)
Cambridge, Massachusetts 02139

Dr. Ernst-Albrecht Marburger
Federal Office for Road Transport
Bruhler Strasse 1
5000 Cologne 51,
Federal Republic of Germany

Mr. Robert Matthews, Consultant
Road Research Program
Organization for Economic
Cooperation and Development
2 Rue Andre Pascal
Paris 16e, France

Mr. Jacques Menard, Chef
Service du Developpement
Transport Terrestre des Personnes
Ministere des Transports
Place Hauteville, 24e etage
700 est, Boulevarde St-Cyrille
Quebec, P.Q. GIR 5A9, Canada

Dr. A. Metcalf
International House
62/72 Chittern Street
London, W1M 2EN, England

Mr. Richard Milbrodt, City Manager
City of South Lake Tahoe
P.O. Box 1210
South Lake Tahoe, California 95705

BEST DOCUMENT AVAILABLE

Mr. Arrigo Mongini
Deputy Associate Administrator for Intercity Programs (RNC-2)
Federal Railroad Administration
U.S. Department of Transportation
400 Seventh Street, S.W.
Washington, D.C. 20590

Mr. Gerard Monot, Chief
Transport Services
Agency for Energy Economics
30 Rue de Cambronne
75737 Paris Cedex 15, France

Mr. Thomas Moore, Senior Fellow
The Hoover Institution
Stanford, California 94305

Mr. Claude Morin, Administrator
Road Research Secretariat
Organization for Economic Cooperation and Development
2 Rue Andre Pascal
Paris 16e, France

Ms. Ann Musyka, President
FIRST PRINCIPLES
19 Wingate Road
Wellesley, Massachusetts 02180

Mr. Sumner Myers, Director
Technology and Transportation
Institute of Public Administration
1717 Massachusetts Avenue, N.W.
Washington, D.C. 20036

Ms. Judith A. Nelson, Consultant
International Secretariat (P-47)
U.S. Department of Transportation
400 Seventh Street, S.W.
Washington, D.C. 20590

Mrs. Keiko Nishimoto
Assistant to the Director
Japanese National Railways
2426 South Queen Street
Arlington, Virginia 22202

Professor Stig Nordqvist
NORDPLAN
Skeppsholmen
11149 Stockholm, Sweden

Mr. Mark R. Norman, Director
Technical and Educational Affairs
Institute of Transportation Engineers
525 School Street, S.W., Suite 410
Washington, D.C. 20024

Mr. Arne Nyquist, Manager
Planning and Organization
Norwegian State Railways
Storgt 33
N-Oslo 1, Norway

Mr. Jeremiah M. O'Driscoll
Director of Safety
Southern Railway System
185 Spring Street, S.W.
Atlanta, Georgia 30303

Mr. Shigeru Ohtsuka, Director
Japanese National Railways
2426 South Queen Street
Arlington, Virginia 22202

Mr. C. Kenneth Orski, Vice President
The German Marshall Fund
11 Dupont Circle, Suite 900
Washington, D.C. 20036

Mr. Donal O'Sullivan
Assistant Chief Engineer
Department of the Environment
O'Connell Bridge House
Dublin 2, Ireland

Mr. Wilfred Owen, Senior Fellow
Brookings Institute, Foreign Policy Studies
1775 Massachusetts Avenue, N.W.
Washington, D. C. 20036

Mr. Hans G. Paar, Assistant Director
Institute for Road Safety Research (SWOV)
Ridder Snouckaertlaan 7
P.O. Box 71
2270 AB Voorburg, The Netherlands

Mr. Joseph Passonneau
Passonneau and Partners
3015-A Q Street, N.W.
Washington, D.C. 20007

Mr. Pierre Pelliard, Urban Engineer
Ministry of Transport - CETUR
8, av. Aristide Briand
92220 Bagneux, France

Mr. James E. Peterson, Executive Director
National Council for Urban Economic Development
1730 K Street, N.W.
Washington, D.C. 20006

Mr. Sverre Pettersen, Deputy Minister
Norwegian Ministry of Transport
Postboks 8010 Dep.
Oslo 1, Norway

Mr. W. R. Pieper
Chief, International Secretariat (P-47)
U.S. Department of Transportation
400 Seventh Street, S.W.
Washington, D.C. 20590

Ms. Cynthia Straker Pierce, Attorney
Office of General Counsel (C-10)
U.S. Department of Transportation
400 Seventh Street, S.W.
Washington, D.C. 20590

BEST DOCUMENT AVAILABLE

Dr. Louis J. Pignataro, Head
Department of Transportation
Planning and Engineering Division
Polytechnic Institute of New York
333 Jay Street
Brooklyn, New York 11201

Dr. Robert R. Piper, Senior Policy Advisor
Department of Economic Development
Transportation Services
10th Floor, Pacific Plaza
10909 Jasper Avenue
Edmonton, Alberta
Canada T5K 3M8

Mr. Robert Z. Prangley
Executive Vice President
ATE Management and Service Co., Inc.
617 Vine Street, Suite 800
Cincinnati, Ohio 45202

Dr. Stephen H. Putman, Associate Professor
City and Regional Planning
University of Pennsylvania
G3 FA/CJ
Philadelphia, Pennsylvania 19104

Mr. Roger Quarterman
Bureau of Transport Economics
P.O. Box 367
Canberra City
ACT 2601, Australia

Mr. Michael Rabins, Acting Director
Urban Transportation Institute
Wayne State University
667 Merrick Street
Detroit, Michigan 48202

Mr. David Ramsett, Senior Economist
Research and Special Programs Administration
U.S. Department of Transportation
400 Seventh Street, S.W.
Washington, D.C. 20590

Mr. George L. Reagle, Office Director
Office of State Program Assistance (NTS-20)
National Highway Traffic Safety Administration
U.S. Department of Transportation
400 Seventh Street, S.W.
Washington, D.C. 20590

Mr. Erik Ribu, Secretary General
Norwegian Ministry of Transport
Postbok 8010 Dep.
Oslo 1, Norway

Ms. Judith Richards, Research Director
National Council for Urban Economic Development
1730 K Street, N.W.
Washington, D.C. 20009

Mr. Paul Roberts
MIT
Page Farm Road
Lincoln, Massachusetts 01773

Dr. Paul O. Roberts
Professor of Transportation
Massachusetts Institute of Technology
Room 1-181
77 Massachusetts Avenue
Cambridge, Massachusetts 02139

Mr. Lee M. Rogers
4909 Barnabas Road, S.W.
Washington, D.C. 20031

Mr. Maurice F. Ronayne, Systems Analyst
Systems Analysis Division (DPB-10)
Research and Special Programs Administration
U.S. Department of Transportation
400 Seventh Street, S.W.
Washington, D.C. 20590

Mr. Daniel Roos, Director
Center for Transportation Studies
Massachusetts Institute of Technology
Cambridge, Massachusetts 02139

Mr. Gabriel Roth
Economic Development Institute
The World Bank
1818 H Street, N.W.
Washington, D.C. 20433

Mr. Ron Roth, Director
Department of Research and Statistical Service
American Trucking Associations
1616 P Street, N.W.
Washington, D.C. 20036

Dr. William D. Rowe, Director
Institute for Risk Analysis
The American University
Massachusetts and Nebraska Avenues, N.W.
Washington, D.C. 20016

Ms. Nancy Rubenson
Special Projects Planning Staff (NPP-30)
National Highway Traffic Safety Administration
U.S. Department of Transportation
400 Seventh Street, S.W.
Washington, D.C. 20590

Dr. Eugene R. Russell, Associate Professor
Civil Engineering Department
Kansas State University
Manhattan, Kansas 66506

Mr. Fred H. Sanborn, Manager
Social and Economic Studies Section
Michigan Department of Transportation
P.O. Box 30050
Lansing, Michigan 48909

Mr. Siegbert Schachnies, Economist
Resource Allocation and Analysis
Division (RRI-31)
Federal Railroad Administration
U.S. Department of Transportation
400 Seventh Street, S.W.
Washington, D.C. 20590

BEST DOCUMENT AVAILABLE

Mr. David W. Schoppert
Senior Vice President
PRC Voorhees
7798 Old Springhouse Road
McLean, Virginia 22102

Ms. Martha Schwendeman
Environmental Program Analyst
Environment Analysis Division (P-22)
U.S. Department of Transportation
400 Seventh Street, S.W.
Washington, D.C. 20590

Mr. Dana Scott
Associate Administrator for
Administration (NAD-01)
National Highway Traffic Safety Administration
U.S. Department of Transportation
400 Seventh Street, S.W.
Washington, D.C. 20590

Mr. James A. Scott, Transportation Planner
Transportation Research Board
2101 Constitution Avenue, N.W.
Washington, D.C. 20418

Mr. William Scott
National Center for Statistics and
Analysis (NRD-30)
National Highway Traffic Safety Administration
U.S. Department of Transportation
400 Seventh Street, S.W.
Washington, D.C. 20590

Professor Leonard Segel
Highway Safety Research Institute
University of Michigan
1337 Orkney Drive
Ann Arbor, Michigan 48103

Mr. Howard J. Simkowitz
Transportation System Management
Branch (HHP-32)
Federal Highway Administration
U.S. Department of Transportation
400 Seventh Street, S.W.
Washington, D.C. 20590

Mr. Paul L. Sitton, Executive Officer
National Academy of Sciences
2101 Constitution Avenue, N.W.
Washington, D.C. 20418

Dr. Philip R. Smith
Department of Social Science
Michigan State University
East Lansing, Michigan 48824

Dr. Richard Soberman, Director
Joint Program in Transportation
University of Toronto-York University
42 St. George
Toronto, Ontario
Canada M5S 1A1

Dr. D. L. Spanton, Director
Office of Rail Safety Research (RRD-10)
Federal Railroad Administration
U.S. Department of Transportation
400 Seventh Street, S.W.
Washington, D.C. 20590

Mr. Robert E. Spicher, Projects Engineer
Transportation Research Board
2101 Constitution Avenue, N.W.
Washington, D.C. 20418

Ms. Diane Steed, Deputy Administrator
National Highway Traffic Safety
Administration (NOA-02)
U.S. Department of Transportation
400 Seventh Street, S.W.
Washington, D.C. 20590

Dr. Wilbur A. Steger, President
CONSAD Research Corporation
121 North Highland Avenue
Pittsburgh, Pennsylvania 15206

Dr. Martin M. Stein, Director
Transportation Research
Abt Associates, Inc.
55 Wheeler Street
Cambridge, Massachusetts 02138

Mr. Pearson H. Stewart
Assistant Secretary for Planning
North Carolina Department of Transportation
P.O. Box 25201
Raleigh, North Carolina 27611

Mr. William Stokes, Senior Vice President
International ATE/DMJM
617 Vine Street, Suite 800
Cincinnati, Ohio 45202

Dr. Richard L. Strombotne, Director
Office of Automotive Fuel Economy
Standards (NRM-20)
National Highway Traffic Safety Administration
U.S. Department of Transportation
400 Seventh Street, S.W.
Washington, D.C. 20590

Dr. Brian E. Sullivan
Assistant Deputy Minister
Government of Alberta
12th Floor, Pacific Plaza
10909 Jasper Avenue
Edmonton, Alberta
Canada T5J 3M8

Mr. Carl Swerdloff, Chief
Economics Study Division (P-14)
Office of the Secretary
U.S. Department of Transportation
400 Seventh Street, S.W.
Washington, D.C. 20590

BEST DOCUMENT AVAILABLE

Dr. Yoji Takahashi
11-45-2 Chome, Kitamagone
Ota, Tokyo
Japan

Mr. Bud Thar, Executive Director
Center for International Transportation Exchange
202 International Center
Michigan State University
East Lansing, Michigan 48824

Mr. Ole Thorson, Civil Engineer
Traffic Department
City of Barcelona
Avenue Puerta del Augel 8-10
Barcelona -2, Spain

Mr. Robert Thurber, Environmental Program Analyst
Environmental Analysis Division (P-22)
U.S. Department of Transportation
400 Seventh Street, S.W.
Washington, D.C. 20590

Mr. Erland A. Tillman, Associate Vice President
Daniel, Mann, Johnson, and Mendenhall
201 North Charles Street
Baltimore, Maryland 21201

Mr. Andras Timar
1400 Budapest
DOBU. 75/81
Hungary

Dr. Frans Timmerman
Ministry of Transport and Public Works
Koninginnegracht 16-21, Room 348
Posthus 20901
2500 EX, The Hague
The Netherlands

Mr. Courtney L. Tucker
International Secretariat (P-47)
U.S. Department of Transportation
400 Seventh Street, S.W.
Washington, D.C. 20590

Mr. John J. Tucker, Director
Rail Activation
Metropolitan Rapid Transit Authority
401 West Peachtree Street, N.W.
Atlanta, Georgia 30365

Mr. C. G. Turner, Principal
Economic and Transport Planning Group
Little House, Devonshire Avenue
Amersham, Bucks, England

Dr. William B. Tye, Principal
Putnam, Hayes and Bartlett, Inc.
50 Church Street
Cambridge, Massachusetts 02138

Mr. Raoul J. Tyrrell, Director
Transport Control Department
P.O. Box 718
Hamilton 5, Bermuda

Mr. Antonio Valdes, Director
Road Engineering
Instituto de Estudios de Transportes
34, Pedro de Valdivia
Madrid 6, Spain

Mr. Richard Van Iderstine, General Engineer
Special Projects Planning Staff (NPP-30)
National Highway Traffic Safety Administration
U.S. Department of Transportation
400 Seventh Street, S.W.
Washington, D.C. 20590

Mr. Jip van Klavern, Engineer
Ministry of Transport and Public Works
Plesmanweg 1
The Hague, The Netherlands

Mr. James Vardon, Director
Transportation Study
W-W-W Interstate Planning Commission
925 Market Street
Parkersburg, West Virginia 26101

Mr. A.C.P. Verster
Erasmus University of Rotterdam
Burgemeester Oudlaan 50
3062 PA Rotterdam
The Netherlands

Mr. Evert J. Visser, Department Head
Netherlands Institute of Transport
Polakwes 13
2288 GG Tyswyk
The Netherlands

Mr. Robert Voas, Director
Office of Program and Demonstration
Evaluation (NTS-12)
National Highway Traffic Safety Administration
U.S. Department of Transportation
400 Seventh Street, S.W.
Washington, D.C. 20590

Mr. Edward J. Ward, Rail Transport Specialist
Transportation Research Board
2101 Constitution Avenue, N.W.
Washington, D.C. 20418

Mr. Arthur L. Webster, II, President
EXP Associates, Inc.
8302 Webster Terrace
Bethesda, Maryland 20034

Dr. F.V. Webster
Transport and Road Research Laboratory
Old Wokingham Road, Crowthorne
Berkshire, England

Dr. Michael Wegener
Institute of Urban and Regional Planning
University of Dortmund
P.O. Box 50 05 00
D-4600 Dortmund
Federal Republic of Germany

BEST DOCUMENT AVAILABLE

Mr. Morton Weinberg, Assistant Director
Maryland Department of Transportation
P.O. Box 8755
Baltimore/Washington International Airport
Baltimore, Maryland 21240

Mr. Edward Weiner, Senior Policy Analyst
Office of Economic Analysis and
Public Investment (P-33)
U.S. Department of Transportation
400 Seventh Street, S.W.
Washington, D.C. 20590

Mr. James K. Williams
Transport Safety Coordinator
Transportation Research Board
2101 Constitution Avenue, N.W.
Washington, D.C. 20418

Mr. David K. Willis, Director
Policy Analysis
Motor Vehicle Manufacturers' Association
1909 K Street, N.W., Suite 300
Washington, D.C. 20006

Mr. S.C. Wilson, Principal Engineering Chief
Countermeasures Development, Road Safety Branch
Transport Canada
Place de Ville
Ottawa, Ontario
Canada K1A ON5

Mr. W.G. Wilson, President
International Road Federation
1023 Washington Building
Washington, D.C. 20005

Mr. David K. Witheford
Engineer of Traffic and Operation
Transportation Research Board
2101 Constitution Avenue, N.W.
Washington, D.C. 20418

Mr. Martin Wohl
Transportation Systems Center (DTS-24)
U.S. Department of Transportation
Kendall Square
Cambridge, Massachusetts 02142

Mr. Philip Wood, Assistant Secretary
D/Transport, Room N9/17
2 Marsham Street
London S.W.I., England

Dr. A.M. Yen, President
Technology Research and Analysis Corporation
2020 14th Street, North (Suite 400)
Arlington, Virginia 22204

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Symposium Director
Voyce J. Mack
Deputy Director, Office of International Policy and Programs,
U.S. Department of Transportation

Symposium Coordinator
Judith Nelson
Consultant, International Secretariat, U.S. Department of Transportation

Symposium Rapporteur
Charles D. Baker
Chairman, Harbridge House, Inc.

Symposium Steering Committee

Office of the Secretary
- Carolyn Blum
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National Highway Traffic Safety Administration
- Joseph Delahanty*
- Nancy Rubenson
- Richard Van Iderstine

Research and Special Programs Administration
- Philip R. Smith*

Transportation Research Board
- James A. Scott

Conference Consultants
Jeffalyn Johnson & Associates, Inc.

(*) Technical Coordinators for the topical workshops.

Requests for additional information concerning the Symposium Proceedings should be directed to:

Voyce J. Mack, Deputy Director, Office of International Policy and Programs, U.S. Department of Transportation, Room 10300 (P-41), 400 7th Street, S.W., Washington, D.C. 20590